

The Relationship of Individual, Team, and Organizational Learning in Ontario Hospital  
Clinical Laboratories

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## Abstract

It is generally accepted among scholars that individual learning and team learning contribute to the concept we refer to as organizational learning. However, a small number of quantitative and qualitative studies that have investigated their relationship reported contradicting results. This thesis investigated the relationship between individual learning, team learning, and organizational learning. A survey instrument was used to collect information on individual learning, team learning, and organizational learning. The study sample comprised of supervisors from the clinical laboratories in teaching hospitals and community hospitals in Ontario.

The analyses utilized a linear regression to investigate the relationship between individual and team learning. The relationship between individual and organizational learning, and team and organizational learning were simultaneously investigated with canonical correlation and set correlation. T-test and multivariate analysis of variance were used to compare the differences in learning scores of respondents employed by laboratories in teaching and those employed by community hospitals. The study validated its tests results with 1,000 bootstrap replications.

Results from this study suggest that there are moderate correlations between individual learning and team learning. The correlation individual learning and organizational learning and team learning and organizational learning appeared to be weak. The scores of the three learning levels show statistically significant differences between respondents from laboratories in teaching hospitals and respondents from community hospitals.

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## CHAPTER ONE: THE PROBLEM

This study investigated the correlations between individual learning, team learning, and organizational learning (OL). It also compared the perception of organizational learning between respondents from laboratories employed in teaching hospitals and those employed in community hospitals in Ontario.

A number of studies have shown a positive relationship between OL and a firms' performance, including their performance related to innovation, competitiveness, and financial results (Baker & Sinkula, 1999; Goh & Ryan, 2008; Jiang & Li, 2008; Lopez, Peon, & Ordas, 2005). For example, Payanides (2007) indicated that OL could improve the relationship between service providers and their clientele. Prieto and Revilla (2006) found that organizational learning improves customer satisfaction as well as employee satisfaction, product quality, and organizational reputation. In addition, firms with higher levels of learning orientation have been shown to have a greater degree of innovation (Calantone, Cavusgil, & Zhao, 2002). This supports McKee's (1992) research that suggested that product innovation was associated with firms exhibiting double-loop learning. According to Argyris and Schon (1978), double loop learning was a process that enabled organizations to detect and correct error that led to changes in underlying norms, policies, and practices.

In the not-for-profit sectors, Birdi, Patterson, and Wood (2007) showed a positive correlation between organizational learning and performances in finance, quality, and innovation. Mohammad and Rad (2006) credited organizational learning as a template for success through patient and employee satisfaction in healthcare organizations. Pedder and MacBeath (2008) advocated organizational learning as a process for improvement in



school leadership and management practices. A study in South Australia and Tasmania suggested that OL had a positive influence on teacher performance, resulted in more student participation in class, increased student confidence of success, and led to a decline in absenteeism and tardiness (Mulford & Silins, 2003; Silins, Mulford, & Zarins, 2002).

Although research has showed positive relationship between OL and organization performance, the concept of how organizations learn is still a subject of debate among scholars and practitioners. There are scholars who suggest that individual learning plays a central role in OL. Argyris and Schon (1978) suggested that “organizational learning occurs when members of the organization act as learning agents for the organization, responding to change such as financial results, innovation, and competitiveness in the internal and external environment” (p. 29). Senge (1990) stated that “organizations learn only through individuals who learn” (p. 139). Marsick and Neaman (1996) illustrated a case of how the Luba, a tribe of people in sub-Sahara African, transferred individual learning to OL. Yang, Watkins, and Marsick (2004) also showed that individual learning correlated with organizational learning. However, there was research that showed no relationship between individual learning and organizational learning. For example, a qualitative study on the relationship between individual learning and organizational learning among managers in the financial services sector in the United Kingdom suggested that individual learning did not have any impact on the latter (Antonacopoulou, 2006). As well, a quantitative study on managers from various government departments, Shell, and other private businesses in Brunei also found no correlation between individual learning and OL (Chan, Lim, & Keasberry, 2003).

In the following sections of this chapter I provide readers with the background to the research problem, empirical questions, and framework of this study. The background section informs readers of the two conflicting quantitative studies that used different survey instrument and statistical methods. These contradictory outcomes of the previous research instigated me to conduct this investigation. The theoretical framework uses a schematic diagram to illustrate how individual learning, team learning, and OL are linked to one another. It informs readers of the type of survey instrument, and its relevant backgrounds. The chapter ends with an overview of Chapters Two, Three, Four, and Five.

### Background of the Research Problem

Social theories provide concepts, assumptions, and specify characteristics of the relationships among concepts. In addition, social theories tell us whether the relationships are strong or weak, direct or indirect, and accelerate or depress each other (Neuman, 2006). Individual learning, team learning, and organizational learning are concepts that social scientists have studied, and learned how they are related to one another with different sets of survey instruments and statistical methods. Yang et al. (2004) used the structure equation model to investigate the relationship among various dimensions of the well-known survey instrument- Dimension of the Learning Organization Questionnaire (DLOQ). They found that individual learning levels correlated with organization learning levels. Their results were in conflict with those of Chan (2003) and Chan, Lim et al. (2003) who utilized the general linear model (GLM) to investigate the same relationship. However, these authors did not investigate the relationships between individual learning (IL) and organizational learning (OL), or team

learning (TL) and OL. Instead, they investigated the relationship of IL or TL with individual components of the OL construct, such as open-mindedness, commitment to learning, and shared vision. This study intended to fill the gap left from previous research.

Research suggests that OL is affected by the size of the organization. Large firms are slower to learn than small firms due to their greater complexity (Lant & Mezias, 1992). Studies in the food packaging sector show that smaller companies score significantly higher in OL than larger firms (Cuthill, 2001). Studies in the healthcare sector indicate that unit size had an effect on research knowledge utilization (Belkhdja, Amara, Landry, & Ouimet, 2007). Bierly and Daly (2007) reported that smaller firms learn more from suppliers and the scientific community, while larger firms learn more from partnership and consultants. Yet, the differences in degree of learning in organizations have never been explored in the healthcare sector, even though some hospitals claim they are learning organizations or organizations that learn (Mount Sinai Hospital, 2003; North York General Hospital, 2008; Trillium Health Centre, 2002). The Ontario Ministry of Health and Long-Term Care (1990) classified hospitals in Ontario into 22 groups, and the top two groups are teaching hospitals and general community hospitals with more than 100 beds. The laboratories in these two groups of hospitals vary in size and complexity.

#### Statement of the Problem

Research on organizational learning often approaches the topic using the qualitative methodology with detailed descriptions (Dobson, Dodsworth, & Miller, 2000; Ribbens, 1997; Tucker, Nemhard, & Edmondson, 2007; Vince & Saleem, 2004).

Quantitative research on organizational learning tends to measure OL and business performance, but there is no one standard survey instrument. Some researchers use instruments that incorporate individual learning (Moilanen, 2005) while others put emphasis on team work (Goh & Richards, 1997). Despite scholars' suggestions that there is a strong need for research to examine the linkages among the three levels of learning, only few quantitative research appear in the literature (Chan, 2003; Chan, Lim et al., 2003; Yang et al., 2004) and these studies show conflicting results. The unsettled issue as to whether individual learning contributes to OL needs to be clarified so we can have a better understanding of the relationship between individual learning, team learning, and organizational learning. Moreover, Chan's (2003) research only shows 7.7% correlation between individual and team learning—a weak support of the general statement that individual learning leads to team learning.

#### Purpose of the Study

The main purpose of this study was to investigate whether there is a correlation between individual learning, team learning, and OL in the clinical laboratories in teaching and community hospitals in Ontario. A secondary purpose was to learn whether there are differences in the degree of learning in the laboratories between the two types of hospitals.

#### Empirical Questions

If individuals act as learning agents in teams and organizations, this study was likely to show a positive correlation between individual learning, team learning, and OL. This notion led to the following questions:

1. Does individual learning correlate with team learning for laboratories in Ontario hospitals?
2. Does individual learning correlate with organizational learning for laboratories in Ontario hospitals?
3. Does team learning correlate with organizational learning for laboratories in Ontario hospitals?

If large organizations are slower in learning, the degree of learning in community hospital laboratories should be greater than that of teaching hospitals, which are usually larger in size. This research asked the following question:

4. How do respondents in the laboratories in teaching hospitals and those in community hospital compare in their perception of organizational learning?

#### Theoretical Framework

The theoretical framework of this thesis was based on the model proposed by Kim (1993) who suggested that individuals or teams act as learning agents on behalf of organizations. The actions of individuals or teams lead to responses from the organization's environment, which confirms or disconfirms individual or team beliefs. These responses result in error detection and correction. For example, a laboratory manager learns from clinicians that the abnormal laboratory reports did not reflect patients' clinical symptoms. The manager investigates the complaint and learns that her laboratory equipment was not functioning to the specified standard. On behalf of the organization, the manager institutes a strict quality control process and sets a new protocol that requires all abnormal laboratory results to be validated by senior staff. The

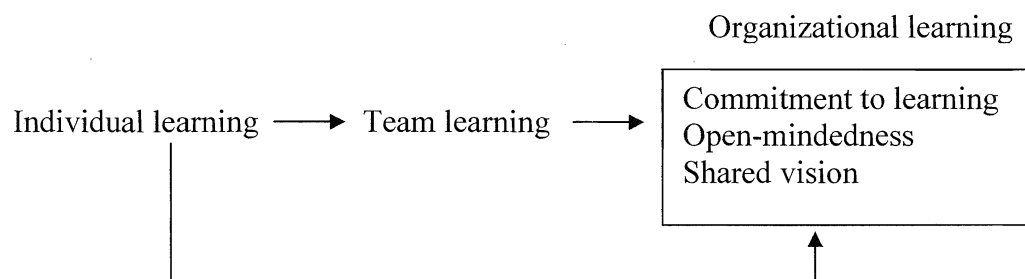
results of these policy changes will confirm or disconfirm the manager's belief that her actions can eliminate the errors.

Sinkula, Baker, and Noordeweir (1997) suggested that the core components of organizational learning were commitment to learning, open-mindedness, and shared vision. Commitment to learning (CL) is one of the organizational values that are likely to promote a learning culture. Organizations are ingrained with models that lead to successes or failures and continue to operate even though they no longer apply to current situations. Open-mindedness (OM) is the organizational ability to question their long held routine assumptions and beliefs. Shared vision (SV) influences the direction of learning. Together, the three components explain the direction and intensity of learning orientation in organizations. Figure 1 shows a schematic diagram of the learning process which integrates Kim's (1993) theory and the three components as suggested by Sinkula et al. The details of Kim's model will be presented in the next chapter.

### Instrumentation

The survey questionnaire (Appendix A) used in this study was developed from the combination of three previous instruments: Sujana, Weitz, and Kumar's (1994) instrument measuring individual learning, Edmondson's (1996) instrument measuring team learning, and Baker and Sinkula's (1999) instrument measuring organizational learning. The three survey instruments were previously used in research for investigating the linkages of learning in organizations (Chan, 2003; Chan, Lim et al., 2003; Chan, Pearson, & Entekin, 2003).

The organizational learning instrument was originally developed by Sinkula et al. (1997) to study the relationship of learning orientation and the formation and



*Figure 1.* A schematic diagram of the investigation.

dissemination of market information. Baker and Sinkula (1999) later modified this instrument and used it to investigate organizational learning and organizational performance.

Edmondson (1999), who defined team learning as “a process and attempt to articulate the behaviour through which such outcomes as adaptation to change, greater understanding, or improve performance” (p. 353), had devised a team learning survey to investigate the association of team shared mental model and team learning oriented behaviours. Edmondson (1996) factored 51 items in her questionnaire into 24 constructs, including team learning-oriented behaviour, which was selected for my survey.

In their study on students’ learning strategies, Ames and Archer (1988) indicated that there were two types of learning goals: mastery and performance. The mastery goal orientation was likely to sustain student involvement and fostered learning. Students who used mastery goal preferred tasks that offered challenge, liked their classes, and believed that success was related to effort. The instrument to measure mastery goal orientation was adopted and modified to measure the individual learning by Sujan et al. (1994).

All of the above survey instruments were previously tested for reliability and construct validity. Sujan et al. (1994) demonstrated the levels of convergent and discriminant validity, and reliability of individual learning with confirmatory factor analysis (CFA). Sinkula et al. (1997) used first and second order CFA to show the reliability and validity of the three components of OL. Edmondson (1996) verified her reliability of team learning orientation with Cronbach’s alpha of 0.78. Edmondson (1996) used discriminant validity and a combination of observers’ survey, in depth interviews and direct observations as external validation. As several investigators (Chan, Lim et al., 2003;



Chang, 2007; Liao, 2006; Sinkula, et al., 1997) had tested the validity of these constructs, this study only applied the reliability test to the data. Items that led to an overall Cronbach's alpha values below 0.7 were dropped out of the analysis.

### Importance of the Study

Hospitals in Ontario understand the potential benefit of OL, and some of them even state on their websites that they are learning organizations (Mount Sinai Hospital, 2003; North York General Hospital, 2008; Trillium Health Centre, 2002). Toronto East General Hospital (2008) even created an "Organizational Learning and Change" department, and the Niagara Health System (2008) incorporated the learning organization concept into its quality of worklife framework. The clinical laboratories, departments within the hospitals, have to work under the general policy of the hospitals. However, there is no published literature on the result of organizational learning surveys of these laboratories. This is the first empirical research on OL of hospital laboratories in Ontario.

Several researchers have shown that organizational learning is associated with organizational performance such as profit, business strategy, customer satisfaction, employee retention, and product innovation (Baker & Sinkula, 1999; Goh & Richards, 1997; Goh & Ryan, 2008; Jiang & Li, 2008). However, very few researchers have studied the relationship of the three learning levels in organizations and their results are not consistent (Chan, 2003; Yang et al., 2004). This study will increase the understanding of the relationship among the three learning levels. The results can benefit hospital executives in two aspects. First, they will learn about laboratory managers' perception on OL. Second, they will know where to target their educational resource to promote OL.

For example, if individual learning does not show a relationship with OL, hospital executives can direct their learning fund toward team learning.

### Scope and Limitations of the Study

The participation of this study was voluntary and anonymous; therefore, I could not verify whether the returned surveys were evenly distributed in all healthcare regions of Ontario. In addition, this quantitative survey did not make any observation on how people interacted and behaved in their work environment. Therefore, the survey, indeed, only asked people about their perceptions with regard to the learning in their organizations. These could be sources of biases in the study.

The focus of this study was the relationship of individual, team, and organizational learning in the not-for-profit clinical laboratories in Ontario. To further narrow the scope, this research only surveyed laboratory supervisors in acute care general hospitals with more than 100 beds. This is because laboratory supervisors are the conduit of communications between top managers and their subordinates. They have better access to information, continuing education, and shape the education budget in the laboratory. They are the persons who decide the format of continuing education, select employees for special training, and authorize payment for education courses. This study excluded psychiatric hospitals, rehabilitation centres, and chronic care institutes because they do not perform significant amounts of laboratory tests in-house and have small numbers of laboratory staff. It would be a much greater undertaking to expand this study to the entire hospital system in Ontario. There was a study on the relationship of the three learning levels that included all departments, but limited to a single hospital (Chan, 2003). There was another similar study that investigated the relationship of nurses and organization

effectiveness (Jeong, Lee, Kim, Lee, & Kim, 2007). The results of my study are only applicable to hospital clinical laboratories, which are different from other disciplines of diagnostic laboratories such as those performing nuclear medicine, cardiology, respiratory and pulmonary functions. Finally, Edmondson (2002) reported that OL did not happen uniformly across the organization. Therefore, results of this study may only be applied to laboratories, and not to other departments.

Survey research often confronts with nonresponse, which leads to a reduction in sample size and a possible bias. Rogelberg and Luong (1998) suggested that lower education and lack of interest in the topic were consistent characteristics of nonrespondents. They recommended readers to learn about the characteristics of nonrespondents, including attitude, personality, and sociodemographics. Lynn (2008) suggested readers make contact, obtain cooperation, and estimate the nonresponse error. Lynn admitted that estimating the non response error is a big challenge and advised readers to use available auxiliary data, such as past response rate among the various groups of respondents. Gerrits and van den Oord (2001) devised a formula for biased indices for mean and correlation, but they required researchers to estimate the variance of covariance using values from peers of the nonresponse subjects. Viswesvaran, Barrick, and Ones (1993) assessed the robustness of survey data by estimating the critical response rate (CRR). The CRR will inform the researchers whether their surveys require 100% response rate. If 70% of those surveyed are in agreement, the remaining 30% will have less impact on the conclusion. However, this method requires researchers to guesstimate an average value of the nonresponse group which can affect the research conclusion. Moreover, their method only applies to t- and F-test. The above three

methods suggest that there is no effective way of dealing with nonresponse bias. Yet, increasing more responses does not necessarily improve the results. Bebbington (1970) illustrated this point by showing a survey that asked respondents three known attributes: possessing overseas contacts, gender, and age. The initial return survey results showed 3-5% difference from the actual figure. To increase the return rate, the researcher sent two follow-up letters to encourage participants to complete the questionnaire. Surprisingly, as the nonresponse rate was reduced, the researcher learned that two of the three questions did not converge to the true population figure. One showed no improvement, another diverged away from the true population figure (increase from 5% to 6%). A more recent study also indicates that there is no minimum response rate, which is an indicator of survey bias. Conversely, there is no maximum survey response rate that is an indicator of nonbias (Singer, 2006). These results suggest that although high response rate is desirable, there is no guarantee that results will not be biased.

For a small sample size, researchers can combine several statistical methods to improve their results. Venter and Maxwell (1999) advised readers to maximize statistical power. Yung and Chan (1999) suggested bootstrap as a method in the social and behavioural science. For missing value, Graham and Schafer (1999) advocated imputation for multivariate data. My research incorporated all of these techniques in the study as explained in Chapter Three.

Because of these limitations in survey and experiment, researchers cannot rely on one study to support a causal hypothesis in social sciences. As Borenstein, Hedge, Higgins, and Rothstein (2009) pointed out “the logic of looking at the body of evidence,

rather than trying to understand studies in isolation, is always compelling” (p. xxi). Neal and Liebert (1986) made the following observation:

By now it should be clear that no one study, however shrewdly designed and carefully executed, can provide convincing support for a causal hypothesis or theoretical statement in the social sciences. Indeed, even the more advanced material sciences, such as physics and chemistry, have come to abandon the seductive notion that one crucial experiment can ever adequately establish a theoretical point by itself. Too many possible (if not plausible) confounds, limitations or generality, and alternative interpretations can be offered for any one observation. Moreover, each of the basic methods of research (experimental, correlational, and case study) and techniques of comparison (within- or between-subject) has intrinsic limitations.

How, then, does social science theory advance through research? The answer is, by collecting a diverse body of evidence about any major theoretical proposition. When evidence converges from many sources that a particular relationship holds or a particular process controls some aspect of behaviour, then (but only then) can reasonable, scientifically admissible conclusions be reached about the relative worth of different theoretical accounts of behaviour. (p. 290)

#### Overview of the Following Chapters

The relationship between individual learning and organizational learning is still a subject of debate among scholars. Although many of them suggest that the individual is the agent of organizational learning, quantitative as well as qualitative research on the linkages shows conflicting results. This research investigated the linkages between

individual learning and team learning, between individual learning and organizational learning, and between team learning and organizational learning. In addition, it also investigated whether the combined construct of individual learning and team learning show any correlation with organizational learning.

This thesis comprises five chapters. Chapter Two contains a literature review on the past and current research. It shows how scholars defined OL and its related term learning organization, followed by the role of organization memory, emotion, and factors that promote learning in organization. The thesis also reviews the various models of linkages between individual, team, and OL, using reproductions of tables and figures (with permissions from the authors and publishers) to illustrate the key concepts. The chapter ends with the discussion on how corporation size affects learning in organizations, and what constitutes the dimension of organizational learning.

Chapter Three presents the readers with methodology and procedures that I used in this research. It shows the calculation of the sample size, tells the readers where and how I collected data. The chapter uses flowcharts to outline the investigation process, including how the research handled the issues of normality and the outliers in both univariate and multivariate data analyses. It informs the readers as to why I selected the specific types of statistical procedures, including the validation method, which was a bootstrap technique.

Results from this research are presented in tabulated and graphic formats in Chapter Four. Statistical programs generated many pages of data of which many were not relevant in the report. SYSTAT generated more than 3,000 pages of data from the bootstrap technique. The script commands (Appendices B and C), which are attached to

the end of the thesis, will be useful for other researchers who want to learn how to write a computer program. The last chapter discusses the results of individual survey items and the relationship of the three learning constructs. The thesis compares its finding with other researchers' quantitative results. It gives reasons as to why the results from this survey are different from the work of other researchers. Finally, it makes suggestions for future research.

## CHAPTER TWO: REVIEW OF RELATED LITERATURE

This chapter reviews the literature on OL that informed this study. It begins with the definitions and four schools of thought on OL. It also reviews the issue of whether organizations learn, and the differences between OL and its related term, learning organization. There are scholars who explain how organizations learn by using human characteristics such as growth, emotion, and memory. Other scholars explain OL by using a combination of organizational structure, culture, leadership, and psychology. At least four theories of linkages between individual learning, team learning, and OL are published in the literature. Sizes and attributes of OL are the last two topics of discussion in this chapter.

There are many OL definitions. Tsang (1997) gave examples of six definitions of OL in his review. These did not even include the original definition by Argyris and Schon (1978) who described OL as “Experience-based improvement in organization task performance of individual decision-makers whose learning comes to be encoded in organization maps, memories and program” (p. 323). Watkins (1996) explained that organizations learned when they acquired new skills and really changed their practices. These changes do not necessarily make differences to individual levels but it is the change capacity at the organizational level that constitutes organizational learning. When an organization closes down its operation because of an economic downturn, it does not mean that it learns. An organization learns when it uses a new approach to run its operation such as switching from a public corporation to employee ownership. Examples of other definitions are “organizational learning is defined as increasing an organization’s capacity to take effective action” (Kim, 1993, p. 43) and “organizational learning is the



process of how individuals understand, reflect and manage their experiences as a collective will” (Yeo, 2002b, p. 120). Collinson and Cook (2007) defined organizational learning as “the deliberate use of individual, group, and system learning to embed new thinking and practices that continuously renew and transform the organization in ways that support a shared aim” (p. 8). This definition appears to blend with the related term, the learning organization (LO), which became popular in the management field in the last decade because of Senge’s (1990) book, *The Fifth Discipline: The art and practice of the learning organization*. Senge defined LO as “organizations where people continually expand their capacity to create the results they truly desire” (p. 3). The book suggests that for an organization to be effective and make the whole organization greater than the sum of its parts, the organization has to master the five disciplines: system thinking, personal mastery, mental model, shared vision, and team learning. The terms OL and LO are confusing and difficult to differentiate. However, scholars now generally agree that OL is a process and descriptive in nature, while LO is an ideal type of organization (Edmondson & Moingeon, 1998; Rebelo & Gomes, 2008).

According to Collinson and Cook (2007), there were at least four schools of thought on OL:

1. Argyris and Schon - Two of the most influential scholars who suggested the link between inquiry and error detection and correction as a key to OL. Individual learning becomes OL when it is embedded in organizational theories-in-use.
2. Draft and Weick – These two scholars viewed OL as an interpretation system in which organizations try to make sense of their environment. Their theory assumes that there is a correct answer to the problem facing the organization. Thus

organizations must collect information, and interpret them prior to taking action.

To Draft and Weick, organizations learn only when they take action.

3. Fiol and Lyles – They viewed OL as a development of insight and knowledge that associate past actions to future actions. To these authors, OL must lead to behavioural and cognitive changes. Changes in behaviours alone do not constitute learning.
4. Levitt and March - OL is explained in terms of routine based, history- dependent and target-oriented. Organizations learn when they encode inferences from history into their routine – rules, procedures, conventions, strategies and technology. Because outcomes indicate success or failure, organizations are target-oriented.

Romme and Dillen (1997) categorized OL literature according to the research disciplines: contingency theory, psychology approach, information theory, and system dynamics. The contingency theory views an organization as an open system that continually adapts to the surrounding environment. The psychology approach implies that organizations translate the internal and external environment to fit their frame of reference. According to the information theory, learning can be viewed as processes of acquisition, distribution, interpretation, and storage of information. System dynamics considers an organization as a complex system that requires a holistic view to fully appreciate and understand. The last category appears to be borrowed from Senge's (1990) system thinking.

Like Romme and Dillon (1997), DiBella and Nevis (1998), who reviewed LO, also brought OL into their book. The authors suggested that LO has three perspectives:

normative, development, and capability. The normative perspective assumes that not all organizations learn. Learning takes place in only certain conditions, and organizations have to apply effort to make themselves learn. The authors cited the work of several researchers, including Senge's (1990) *The Fifth Discipline*, Pedler, Burgoyne, and Boydell's (1997) *The Learning Company*, and Watkins and Marsick's (1993) *Sculpting the Learning Organization*. Using the development perspective, DiBella and Nevis suggested that organizations had their own life cycles, and learning in organizations was different throughout their stage of development. Examples of this category came from the concepts of scholars in the OL camp such as Argyris and Schon (1978). Unlike the above two categories, the capability perspective assumes that all organizations learn and they can improve through their existing learning process and style. Therefore, there is no generic prescription on how to improve organizational performance. Learning has to be tailored to fit into organizational structures. Researchers in this group include, among others, the authors themselves and Kim (1993) who proposed a model of the linkages between individual learning and OL.

There is a large number of research with normative and development perspectives. The supporters of normative perspective develop several diagnostic tools for LO (French & DeVilbiss, 2000; Goh & Richards, 1997; Marsick & Neaman, 1996; Marsick & Watkins, 2003; Moilanen, 2005; Pedler et al., 1997). The development perspective puts human characteristics into organizations. The anthropomorphism includes past success and failure (Carroll, Rudolph, & Hatakenaka, 2003; Starbuck & Hedberg, 2001), the role of time (Weber & Antal, 2001), and emotion (Scherer & Tran, 2001).

A number of scholars see the confusion and try to show the differences between LO and OL (Easterly-Smith, Crossan, & Nicolini, 2000; Edmondson & Moingeon, 1998; Ortenblad, 2001). All these scholars agree that OL is a process and the research in this area is more descriptive. LO, on the other hand, is a form of organization, a desirable end stage, and its research is prescriptive in nature. Leithwood, Jantzi, and Steinbach (1995) succinctly defined “the learning organization is one promising vision for the future schools and organizational learning is a promising perspective on the processes of getting there” (p. 230). In addition, LO researchers draw information from OL literature rather than the other way. Table 1 summarizes the differences of the two concepts.

#### Organizational Learning Styles

There are as many organizational learning styles as there are individuals. Miller (1996) used the two dimensions of contrast, voluntarism vs. determinism and methods vs. emergence - to develop five criteria: (a) goals, (b) learning devices, (c) analysis, (d) choice, and (e) what organizations learn. With these five criteria, organizational learning is categorized into six stages: (a) analytical, (b) synthetic, (c) experimental, (d) interactive, (e) structural, and (f) institutional learning. At the analytical stage, learning is diffused and happens at the upper echelons of the organizations. Organizations gather information by scanning the internal and external environment for key problems. Synthetic learning gets organizations into the hidden meaning of the issues. High level managers look at issues or problems and understand how they fit together. With experimental learning the middle managers try out and monitor small projects to resolve their problems. The interactive learning involves the exchange of information among

Table 1

*Comparison of OL and LO*

Attribute	Organizational learning (OL)	Learning organization (LO)
Perspective	Descriptive	Prescriptive
	Process	Organization form
	Exists naturally	Needs activity
	Neutral	Preferable
Target audience	Academics	Consultants, practitioners
Objective	Theory building	Improving organization performances
Methodology	Rigorous research methods	Rough case studies and action research
Outcome of learning	Potential behaviour change	Actual behaviour change
Key question	How do organizations learn?	How should organizations learn?
Sources of information	Systemic data collection	Consulting experience

*Note.* From “Organizational Learning and Learning Organization: A Dichotomy Between Descriptive and Prescriptive Research” by Eric W. K. Tsang, 1997, Human Relations, Vol. 50, No. 1, p. 85. Copyright 1997 by Eric W.K. Tsang. Reprinted with permission.

various groups inside and outside the organizations. An example of interactive learning is when people from two departments bargain for the limited amount of capital budget. In doing so, they learn what resources the opposite party is willing to relinquish or what projects it can delay. Structural learning happens at the lower levels in organizations, where people learn about daily procedures such as quality control and daily routines. Institutional learning is organization-wide, where people learn about values and ideologies of the organization. As they progress through their life cycle, organizations usually go through all these six stages although not necessarily in the same order. It depends on the immediate situations that organizations encounter. For example, experimental learning is most common when there is a high uncertainty about the process of achieving the goal because it allows a piecemeal exploration rather than long term plans.

Ribbens (1997) used 2 x 2 learning style grids to categorize organizations into four types based on adults learning styles: (a) abstract-random, (b) abstract-sequential, (c) concrete-random, and (d) concrete-sequential. Abstract-random and abstract-sequential styles prefer to use theory and models to learn but with differences in communication strategy. Abstract-random prefers cooperative work and share information, while abstract-sequential likes to work alone and prefers logical explanations and keeps things in order. This type of organization is likely to have many formal lines of communication. Concrete-random style will try new things, takes risks, and experiments. Concrete-sequential is a typical hierarchical organization that has a clear line of authority. Organizations are predisposed to one of these four learning styles based on the industry

they operate under. For example, a pharmaceutical company will be abstract-sequential because its business is technologically oriented and knowledge-based. Medical clinics and consulting firms will demonstrate abstract-random traits since they are sensitive to their environment and need to adapt quickly to change. High tech firms normally fall in the concrete-random category because they have a volatile environment. It is difficult for organizations to change their learning styles because of technical demands, competition, and the learning style of the founders. Murray (2002) developed his own organizational learning types. Studying 42 large and small companies in the construction industry in New South Wales, the author found that organizations had five levels of learning behaviour: (a) simplistic-driven learning, (b) structure - driven learning, (c) efficiency-driven learning, (d) value-driven learning, and (e) dynamic-driven learning. The author suggested that organizations that fell into the value-driven and dynamic-driven learning levels would challenge the institutionalized practices. This was because with the other three learning behaviours, organizations simply made adaptive learning or coped with the problems. They did not question their assumptions and the embedded cultures prevented them from seeing things in different perspectives.

### The Role of Memory

In order for organizations to learn, they need memories. People capture learning into a variety of formats (e.g., symbols, diaries, and reports), and recall them when future needs arise. Marsick and Neaman (1996) illustrated a case of how organizational memory functioned with the Luba, an African tribe, who lived in Lake Tanganyika, southern Zaire. The Luba were the originators of the Lukasa, which was described by the authors as “A mnemonic device. ‘A handheld, flat wooden object studded with beads and

pins, or covered with incised or carved ideograms’” (p. 97). Lukasa represented a conceptual map that told the trained “men of memory” about the spirit, culture, political system, and historical state of the Luba tribe. The interpretation of the Lusaka was contextual, subjective to interpretation, and passed through generations of the Luba people.

Walsh and Ungson (1991) proposed an organizational memory model that comprised five compartments: (a) individual, (b) culture, (c) transformation, (d) structure, and (e) ecology. Information in these compartments and external archives must be retrievable for members for organizations to learn. This concept is an expansion of the transactive memory system (TMS) which is an individual memory plus the communication system of individuals. TMS has three types based on the exchange of information: (a) between groups, (b) between group and individuals, and (c) between individuals of different groups (Lehner & Maier, 2000). Weick and Westley (1996) did not use the term memory but suggested that organizational learning had three basic concepts: (a) culture, (b) repositories of learning, and (c) self-designing system. Culture embodied language, words, phrases, material objects a group produces, and the coordinated action routines. Repositories of learning included missions, facts, operational procedures, stories of past experience, and maxim of practice. A self-designing system blended the culture and repositories, allowing organizations to question the governing assumptions and reassess their relationship with the changing environment. Van der Bent, Paauwe, and Williams (1999) pursued the notion of organizational learning by further developing Weick and Westly’s idea into a memory carrier concept. They conducted a longitudinal study of Phillips Corporation, a Dutch electronics firm, from



1982 to 1994 and found that organizational memory carriers were usually based on past success, and not all organizational memory carriers lead to organizational learning.

### Organizational Emotion

Research suggests that organization memory is not the only human character that affects OL but emotion also influences learning. Members of the same organization usually share common assumptions with their employers. Changes in organizations can alter the emotional climate that affects the OL process. Scherer and Tran (2001) proposed five classes of organizational emotion that could affect OL.

1. The approach emotion fosters exploration, development and provides motivation to continue their activities toward common goals.
2. The achievement emotion indicates satisfaction, sense of relief, and elation.
3. The deterrent emotion serves as a warning for danger and negative consequences.
4. Withdrawal emotions represent sadness, resignation, shame and guilt.
5. Antagonistic emotions represent anger, hate and aggressiveness. (p. 385)

Leaders can benefit by observing the collective emotions of organization members. For example, the climate of interest and hope enhance exploration and creativity. On the other hand, the deterrent emotion which happens when team members are in fear, anger, and distress is detrimental to learning.

### Conditions that Foster Organizational Learning

Memory, emotion, and styles are human characteristics that many authors used to convey their messages on organizational learning. But organizations are not human beings, and some scholars express doubt about OL concepts. Weick and Westley (1996) suggested that OL is an oxymoron because “to learn is to disorganize and increase

variety. To organize is to forget and reduce variety” (p. 440). March and Olsen (1976) also questioned the OL perspective based on the ambiguity of environment, short attention span, and considerable human tolerance level for inconsistency. Their propositions show how subjective human beings are about the things that they like or dislike. Because OL depends largely on human decision, the subjectivity of what we like or dislike makes it difficult to develop an OL theory that is based on the observation of our reactions. In *Demystifying Organizational Learning*, Lipshitz, Friedman, and Popper (2007) advised readers to avoid the pitfall of applying human abilities to organizations. These authors suggested that OL can be better approached by using the five facets: (a) structure, (b) culture, (c) psychology, (d) leadership, and (e) context. In education research, Marks and Louise (1999) linked OL to teacher empowerment and also pointed out that structures, shared commitment, knowledge, leadership and feedback were factors that promoted or impeded learning processes among teachers. They learned that teachers were too busy teaching students and did not have enough free time to collaborate, share knowledge, and receive feedback.

### *Structural Aspect*

Structural aspect refers to the mechanism in organizations that encourage members to collectively exchange, analyze, disseminate, and apply information and knowledge. Barrette, Lemyre, Corneil, and Beauregard (2007) learned that decision latitude that employees had over their work played an important role in the acquisition of OL. In education, OL requires a decentralized leadership, not centralized in the head office such as the district office, and school board. Centralized leadership where decision making is consolidated at the head office does not promote learning in organizations

because teachers require both formal and informal learning. Teachers learn from formal structures such as scheduled professional development inside and outside schools and visits to other schools. They also learn informally from colleagues and from their own experiences in classes (Leithwood, Jantzi, & Steinbach, 1998). Imants (2003) reported two basic mechanisms for OL in school settings: (a) steering of information about teaching, and (b) student learning and interaction among teachers and other workers around school. Steering information exhibits in the form of developing programs and curricula and evaluating student performance. The interaction of teachers should be a collaborative approach in which individuals can share their expertise in the common problem (Steele & Boudett, 2009). However, collaboration also has its down side since it can lead to disagreement and micropolitics which influence the decision-making process. Achinstein (2002) studied two middle schools in the San Francisco bay area, where teachers used the collaboration process to reach a decision on how to address poor academic performances among immigrant and poor children. One school used collaboration as a method to isolate a dissident teacher so the majority could maintain their status quo. Teachers in another school also encountered a dissident colleague, but were more open minded and used a different approach. Rather than isolating the dissident from participation, they questioned their own assumption and developed a program to help poor black children to improve academic performance even though it led to segregation in the school.

Community of practice is another mechanism that can improve learning in organizations. Community of practice differs from teamwork, since community of practice is voluntary and focuses on improving professional skill and knowledge. Team

work, on the other hand, focuses on a specific task and is assigned by the organization (Mitchell & Sackney, 1998).

Learning is likely to happen when the cost of a mistake is high. One of the most effective ways of learning in an air force unit is briefing or after-action review. In a sky combat, enemies come from all directions; therefore, pilots need a high degree of coordination as mistakes are fatal. Fighter pilots in the Israeli defence air force have to go through intensive gruelling after-action review from peers and superiors. They all agree that the process is unsympathetic for the wrongdoer pilots but it is necessary since they have to know what went wrong in order to correct the errors (Lipshitz et al., 2007).

### *Cultural Aspects*

The cultural facet supports creation and takes action on valid knowledge. Sabah and Orthner (2007) proposed four cultural dimensions that promotes OL: (a) innovation (beliefs that support new idea), (b) safety (beliefs that promote freedom of discussion), (c) goal-centered (beliefs that encourage goal development), and (d) leadership (philosophy that encourages new ideas). Lipshitz et al. (2007) suggested that culture that encourages OL comprises inquiry, issue orientation, transparency, integrity, and accountability. Members of the organization must put effort on not accepting things at face value. Inquiry does not necessarily lead to solutions but it can improve team members' knowledge and understanding of the issues. Issue orientation keeps inquiry focuses on the knowledge that can improve organization performance. Lipshitz et al. gave a vignette of teachers' frustration because they were not able to take strong action against a student who threw a chair in a class. This group of teachers felt powerless, and blamed the Ministry of Education for weakening them by taking away their authority. The

consultant had to orient teachers to focus on how to deal with children who showed bad behaviour, not how to reclaim their authority. Transparency is the willingness to let the public scrutinize your own ideas and decision. It only happens when members are willing to express their reasons in the meeting without being ridiculed or feeling bad when learning about their own errors. This requires integrity and accountability of the team members who are willing to admit that they made a mistake in front of the public. Accountability is an issue when people do not want to face their own failure. When researchers study how teachers utilized standardized test scores to measure teachers' effectiveness, they find that high school teachers do not want to accept standardized test scores as an indicator for their teaching ability. They avoid accountability by pointing out that how children interact in social settings, and employment after high school are more important (Ingram, Louis, & Schroeder, 2004).

### *Psychological Safety*

The psychological facet suggests that people will be willing to explore and take risk only when they have psychological safety. Organizations learn when members make their commitment to improve organizational performance. To promote this type of commitment, organizations need to provide psychological safety, which encourages members to speak their minds without being afraid of offending their superiors and colleagues. They must be willing to disagree and open their minds to those who have different ideas. A middle school in San Francisco, where a group of teachers decided to segregate black children into their own classroom, is a good example of how disagreement created innovative solutions. Even though many teachers disagreed with the idea of racial segregation, they were willing to give it a try (Imants, 2003).

### *Leadership*

Structure, cultural, and psychological facets must be supported by the leaders who can facilitate and foster organizational learning. Leaders have legitimate authority that can promote OL in organizations. Leaders can allocate resources, set organizations' agenda, reward, and discipline their subordinates. To encourage learning in an organization, leaders must have a tolerance for mistakes, be patient and willing to coach their staff. Leaders must set examples, walk the talk, and sell their ideas to persuade the followers (Lipshitz et al., 2007). However, scholars suggest that the traditional leadership system where decision-making power rests with the school board and district office leaves teachers with despair and feeling powerless. Instead, scholars propose a distributed leadership as a solution to the difficulty that faces the school system (Boris-Schacter & Langer, 2006; Marks & Louis, 1999; Scribner, Sawyer, Watson, & Myers, 2007). Distributed leadership gains support among educational scholars as one of the factors to improve OL and increase school efficiency (Marks & Louis; Maryrowetz, 2008; Scribner et al.). Boris-Schacter and Langer even extend a model of distributed leadership in schools that includes other professionals in the building. Distributed leadership means more than sharing leader functions among those with ability and experience. "It is a product of joint interaction of leaders, their followers and aspects of their situation" (Wilkinson, 2007, para 4). Temperly (2009) suggests that distributed leadership comprises dynamic interactions between multiple leaders and followers. Decisions on who are the leaders and followers are not dependent on the hierarchical nature, but dictated by the task or situation.

### *Contextual Factors*

The contextual facet is related to external factors, such as task uncertainty, business, and political environment, which exert influence on OL. Leaders in organizations can provide psychological safety, improve structural aspect, and set the cultural trend. Yet, the likelihood that organizational learning will take place depends on the organizations' characteristics and environment. Lipshitz et al. (2007) identified six contextual factors that promote or deter organizational learning. They are (a) environmental uncertainty, (b) task uncertainty, (c) error criticality, (d) task structure, (e) organizational structure, and (f) proximity to the organization's mission.

*Environment and task uncertainty.* Environment uncertainty creates doubt and instigates people to seek information that help them analyze and solve problems by developing alternative scenarios and learning how to deal with them. When employees face unfamiliar tasks after departmental consolidation, they would have to learn new skills and be cross-trained to make them employable. People are more likely to engage in learning when the cost of mistakes is high. Studies have showed that air traffic controllers and high-tech managers produced higher scores on tests that measure integrity and transparency than those of teachers and psychiatrists (Ellis, Caridi, Lipshitz, & Popper, 1999).

*Error criticality.* Task structure that promotes feedback and interdependence encourages learning. Tasks that are critical to failure get more attention from learners. For example, the chance of survival of one fighter pilot during combat is dependent on the skills of his colleagues as much as his own. They have to learn how to coordinate, understand, and trust their colleagues.

*Task and organizational structure.* The division of labour in organizations hinders learning and exchange of ideas and information for the reason that different units have different goals. Moreover, people have loyalties to their own departments. Lipshitz et al. (2007) suggested two methods to tackle these weaknesses. The first method is to create a centralized organizational learning mechanism that collects information and knowledge from all departments. For large organizations with multiple geographic locations, the authors advised readers to set up programs such as communities of practice, peer assists, and computerized knowledge.

*Proximity to organizational mission.* Organizations usually pay more attention and provide more resources to tasks that are important to their core mission. Although Women's College Hospital provides services to male patients, it has its primary focus on women's health. Therefore, programs which focus on women's health will receive more attention and resources.

### Agents of Organizational Learning

Organizations learn through their individuals who act as agents to create knowledge. These agents consist of front line employees (Friedman, 2001), leaders (Sadler, 2001), board members (Tainio, Lilja, & Santalainen, 2001), labour unions (Drinkuth, Riegler, & Wolff, 2001), and consultants (Antal & Krebsbach-Gnath, 2001). In order to make knowledge explicit, individuals have to work within groups or teams so they can share information. Friedman learned that individuals who were likely to act as agents in organizations that learn were people who were critical, proactive, had high aspirations, and were independent but cooperative. They were thinkers who invested their time to inquire and analyze the problems. They did not like to complain, and were



driven by values that they held deeply. However, these individuals were more successful in persuading organizations to learn when problems were easily defined and identifiable, and when people in the organization agreed to the same problems.

Leaders who act as a link in organizational learning see themselves as change agents. They show courage, believe in people, are able to draw inspiration, and cope with complexity. A transformation leader believes in lifelong learning and views mistakes as an opportunity to learn (Sadler, 2001). Transaction leaders, on the other hand, believe that people are looking after themselves and only do minimum work. This type of leader prefers to use a carrot or a stick to achieve his/her goals (Bass, 1997).

Members of the board of directors also play a role in organizational learning. Taino et al. (2001) looked at the relative powers of chief executive officers and their boards and categorized them into four types. Caretaker boards do not facilitate organizational learning. This type of board has low power and coexists with the chief executive officer (CEO), who also has minimum power. Caretaker board members do not enhance the discussion of new ideas, and tend to be passive or indifferent about learning in organizations. Statutory boards also have relatively low power, in comparison to the CEOs, who are the central figure in decision making. These board members do not have expertise and leave the decision to the CEOs. CEOs consider board members as a nuisance and do not treat them as real partners. These board members do not foster organizational learning. It is management driven. The proactive boards have more power than those of the CEOs. Proactive boards have high levels of expertise and members usually come from outside organizations. Usually, they are the representatives of shareholders and can replace management to protect their interest. Participative boards

are characterized by high board power and high CEO power. These board members fully participate in the debate and resolve the conflict. This type of board is the major source of organizational learning.

Usually, labour unions are not considered as learning agents. Nevertheless, the globalization of the world economy makes labour unions aware that they cannot hold on to the win-lose situation. Over the years, labour unions have become proactive in decision making such as orderly layoff, cost cutting, and plant closing. The participation makes union members understand the complex issues that managers and leaders are facing in their daily operation. The current crisis in the auto industry in which the Canadian Autoworkers Union and United Autoworkers Union are trying to help the survival of Chrysler and General Motor is a good example (Macaluso, 2009; Merk, 2009). Unions have changed their position from maintaining their employment levels to structural change discussion. They have moved from single loop to double loop learning (Drinkuth et al., 2001).

Internal and external consultants help organizations learn through the information processes and examine themselves. These lead to a better understanding and change in practices in organizations. Internal consultants understand internal politics and have better knowledge of the company histories. The disadvantage of internal consultants is the same blind spot that they share with other members in the organization. External consultants provide new insight and make organizations see things in a new light. In addition, these consultants make organizations aware of what is going on in the environment and prompt managers for a need to learn. Through gathering of internal

information, consultants can bring out the hidden internal talents that could provide solutions to organizations (Antal & Krebsbach-Gnath, 2001).

### Linkages of Individual, Team, and Organizational Learning

There are three pairs of learning relationships in organizations: (a) individual and organizational learning, (b) individual and team learning, and (c) team and organizational learning.

#### *Individual and Organizational Learning*

Lewin's experiential learning comprises operational and conceptual modes, which form a cycle of observation/reflection, formation of concepts and generalization, testing of concepts in new situations and experience (Kim, 1993). Kim labels this cycle as observe (O), assess (A), design (D), and implement (I). The O and I are under operational mode, while the A and D are under conceptual mode. Individuals observe events around them and make assessment via reflecting on their observation. The reflection process is the situation where individuals filter the information through their perceptions, beliefs, values, and framing (Marsick & Neaman, 1996). After reflection, individuals design courses of action which they then implement. This four-step process is a cycle that confirms or denies individuals' beliefs.

Individuals can improve their learning by searching for more knowledge from internal and external sources. Mitchell and Sackney (2000) advised readers to reflect on and search for inconsistency of individuals' espoused theory and theory in use. They discussed, as an example, school teachers who invited parents to give them input, when they had already determined the outcome. External sources for knowledge were obtained through professional networking.

People capture learning into their memories, including diaries and reports, and recall them when future needs arise. To improve its knowledge retention, Scalzo (2006) advised corporate leaders to convert tacit knowledge into explicit knowledge through ongoing communication, planning, and commitment of senior personnel. However, studying bank managers in England, Antonacopoulou (2006) found that individual learning was affected by three organizational practices: (a) context of learning, (b) politics of learning at work, and (c) institutional identity of learning. The banking institutes in this study influenced individual learning by defining what and how bank managers should learn. This led to a learning that intended to maintain rather than challenge organization status quo. In other words, individual learning reflected the lack of organizational learning. Her work supported the findings by Chan (2003) and Chan, Lim et al. (2003) that individual learning did not correlate to organization learning. Yet, Yang et al. (2004) found that organizations learned from individuals and teams. March (1991) also reported that an organization learned from its members and accumulated knowledge over time.

#### *Individual and Team Learning*

For every point in an individual cycle of learning, there is an equivalent in team learning. When individuals personally reflect, teams publicly reflect. When the individual tries to connect new ideas through assessment, team members reach out for shared meaning. As individuals plan and decide, teams develop joint planning. Finally, team members coordinate their action just as individuals implement the plan (Ross, Smith, & Roberts, 1994). Senge, Roberts, Ross, Smith, and Kleiner (1994) defined team learning as “transforming conversational and collective thinking skills, so that groups of people can

reliably develop intelligence and ability greater than the sum of individual members' talents" (p. 6). Senge (1990) used the alignment of molecules that transform iron into magnet or several pieces of musical instruments that play in harmony to create jazz music as metaphors to illustrate his theory. Edmondson (2002), on the other hand, viewed team learning as a collective decision to change. She defined team learning as a "process in which a team takes action, obtains and reflects upon feedback, and makes changes to adapt or improve" (p. 129). Mitchell and Sackney (2000) suggested that team learning happened in a collaborative process in which members distributed knowledge and became part of a collective discourse and expanded professional capacity. Effective teams usually operate in a tension free environment. Team members clearly understand their tasks, share a sense of purpose, and do not avoid conflict in disagreement. Team members require learning two things. One is the shared understanding of the team and what collective action is required to accomplish the purposes. Second, as an individual, a person must know what kind of contributions he can make for collective learning of a team (Leithwood, 1998).

Organizations extensively use teams to achieve their objectives such as project teams (Tucker et al., 2007), top management teams (Wu, Chiang, & Jiang, 2002), and product development teams (Lynn, Akgun, & Keskin, 2003). Unlike the debate about the linkages between individual and organizational learning, there is agreement on the relationship of individual and team learning (Chan, Lim et al., 2003; Yang et al., 2004). Studies of six high technology firms in Taiwan suggest that managers can use training as their strategy for the individual to learn, followed by individuals influencing the team members (Lien, Hung, & McLean, 2007). The information that flows from individuals to

teams does not only occur in the study group or training session, it also happens in the hallways, or at coffee machines where individual members get an opportunity to exchange ideas and verify their understanding (Dixon, 1997; Lehesvirta, 2004). This is the process where collective meaning is constructed through dialogue.

Conflict and crisis in organizations can also be a starting point for the individual learning process. It can be found in discussions about frustration, anger, disappointment, and failure by individuals in organizations such as increase in cost and budget, delivery problems, and technical issues (Lehesvirta, 2004). Frustration and disappointment in organizations can lead to withdrawal and demotivate employees from participation and share their knowledge with the group (Lee & Roth, 2007). However, knowledge sharing is just one of the key concepts within team learning development. Other concepts for developing a good team include collaborative action, environment, and personal competence (Sparrow & Heel, 2006). Because managers can control the environment of the workplace, they play a crucial role in individual learning, specifically double loop learning (Turner, Mavin, & Minocha, 2006). Employees who only receive negative feedback can at best have single loop learning. Thus, managers have to encourage their subordinates to challenge assumptions and give them positive feedback.

#### *Team and Organizational Learning*

Professional baseball players work to observe the ball and their teammate reactions. When the ball flies into their territory, the outfielders are supposed to make sure that one of them is able to catch without colliding with their teammates. Whether the pitchers throw a fast ball or curve ball requires communications between the pitchers and the catchers. At the same time, players at the plate will have to know whether the ball will

come their way so they can tack the runners unexpectedly. People in organizations like to take pride that they are team players. When asked whether their workgroup functions as a learning team, staff members usually indicate that it does, even though in reality it is far from evident. There are four important processes that create synergistic teams: (a) interaction, (b) appreciation and understanding, (c) integration, and (d) implementation (Lick, 2006). One of the methods that organizations use to improve their performance is through the team building process. Bayley, Wallace, Spurgeon, Barwell, and Mazelan (2007) made a longitudinal evaluation of the teambuilding process in the healthcare sector in which it involved three phases. Phase one made participants understand working relations, and strengths and weaknesses of themselves and others. Phase two was about conflict handling, openness in team communication, and team decision making. The last phase taught members how to share knowledge, respect, and collaboration. Their finding indicated that training was only beneficial in the area related to the understanding of strengths and weaknesses of team working styles, but not in the other elements of the learning dimensions.

A qualitative research on OL among school teachers suggests that team members go through three phases of learning: (a) naming and framing, (b) analyzing and integrating, and (c) applying and experimenting. In the first phase, team members develop trust through common understanding, shared vision, and engage in corporative practices. In the second phase, team members make a reflective self-analysis to raise awareness of assumptions and beliefs. They engage in dialogue so they can understand others' frames of references. In the final phase, members adopt new frames of reference when they are aware of their incorrect assumptions (Mitchell & Sackney, 1998).

There are empirical evidences to support the long standing hypothesis that team learning enhances team performance (Chan, Pearson et al., 2003; Edmondson, Bohmer, & Pisano, 2001). However, team learning in the same organization is not always uniform as research suggests that task relationship and distribution of power in the team are important features of effective team learning. Edmondson (2002) found three types of teams: (a) teams that reflect and change, (b) teams that reflect without change, and (c) teams that neither reflect nor change. The first type of team is beneficial to the organization as it leads to improvement in the organization. Team members in the second type have task independence which allows them to act separately. The third type has dominant leaders that make team members reluctant to express their opinions and demand change. Another research suggests that teams that engage in real time learning, drawing the lesson while the process is underway, are more effective than those that take action after analysis. This may be due to the fact that team members lose information while waiting for a formal review session (Edmondson et al., 2001).

The above research is in agreement with Altman and Iles (1998), Bontis, Crossan, and Hulland (2002), Kim (1993), and Yeo (2002b), who suggested that organizations learn from both individuals and teams. However, Crossan, Lane, White, and Djurfeldt (1995) suggested that there was a serious need for research to examine the relationship between them.

### Models of Linkages

There is no agreement on how the three learning levels are linked to each other. At least two distinctive models appear in the literature.



### *Individual to Team and Team to Organizational Learning*

The first model is sequential with no inclusions of feedback mechanism between the learning levels. It starts with individuals who seek relevant information for their goals (Yeo, 2002a, 2002b). This leads to learning that is transferred to the teams and, in turn, is passed to the organizations. For an organization to learn, it must incorporate the strategic management plan into consideration. The alignment of strategic management and team learning leads to organizational learning that changes organizational behaviour and employees' attitudes. The author labels the three learning levels as single, double, and triple loop learning (Figure 2).

### *Individual and Team Mutually Influence Organizational Learning*

There are at least three variations in this model. Kim (1993) proposed a more complex model that incorporated Senge's (1992) mental model, Lewinian experiential learning and Argyris and Schon's (1978) single and double loop learning. In his model, individuals use observe-assess-design-implement (OADI) cycle which was reinforced by the mental model to create Weltanschauung (the organization's worldview) and organizational routines. The two components form a shared mental model. Both individual and organization can take actions that elicit environment responses that confirm or deny their beliefs. Kim, however, proposed that individual action comes from single loop learning while organizational action is double loop (Figure 3).

The OADI example can be observed when a child learns how not to touch a hot plate. First the child observes something and touches it without knowing the consequence. The body reflex makes the child pull his hand away from the heat. When the child comes across the same situation again, his observation and assessment of the

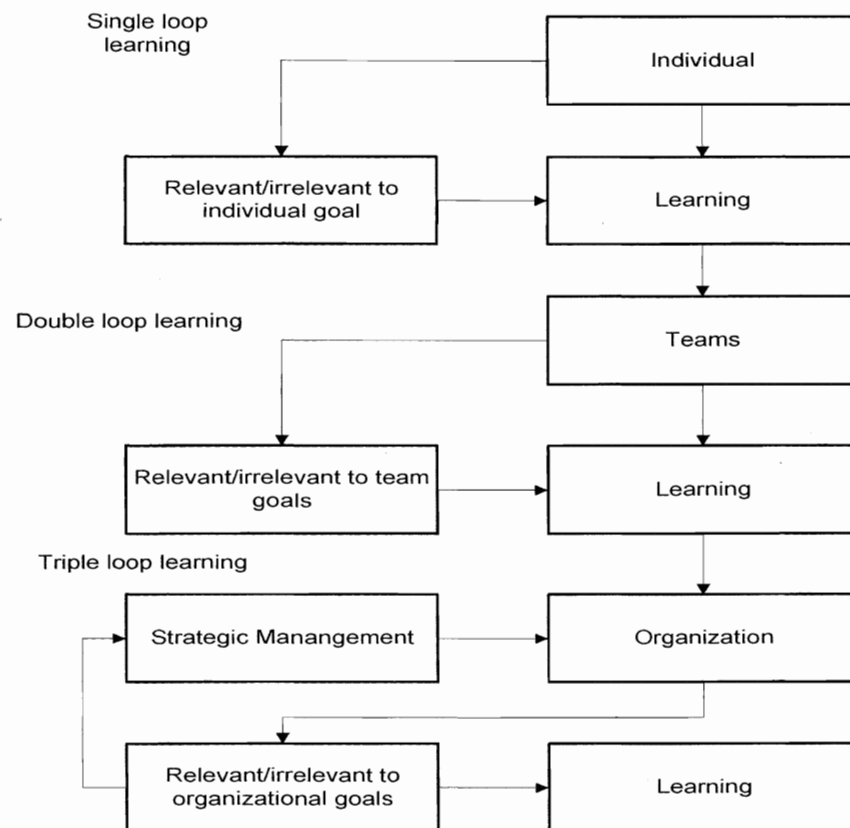
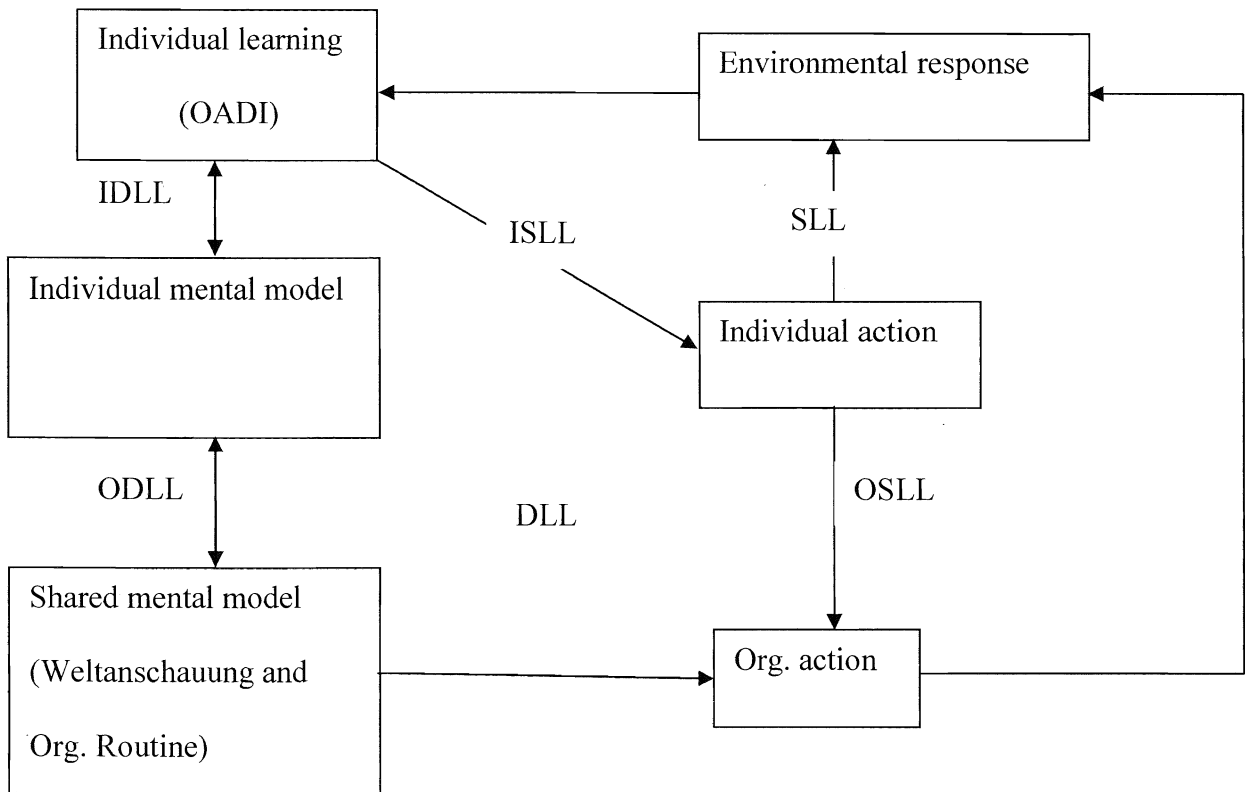


Figure 2. Yeo's organizational learning model.

*Note:* From "Learning within organizations: Linking the theoretical and empirical perspectives" by R. Yeo, 2002. *Journal of Workplace Learning*, Vol.14, No. 3, p.120.

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SLL – single loop learning                      DLL – double loop learning  
 ISLL – individual single loop learning      IDLL – individual double loop learning  
 OSLL – organization single loop learning    DLL – organization double loop learning

*Figure 3.* Kim's organizational learning model.

Note: From "The link between individual and organizational learning", by D.H. Kim

1993. Sloan Management Review, Fall, 1993, p. 44. Copyright 1993 Massachusetts

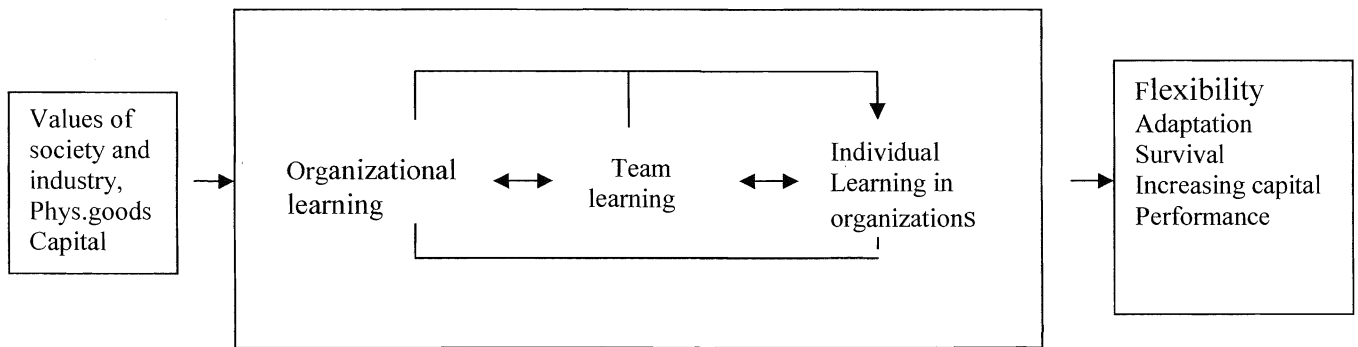
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situation will make him design an action that will not harm himself. He will not touch the plate again.

Kim's (1993) model does not explicitly show team influence, but he considers team as an extension of individuals. Thus, one can replace "individual" in the model with "team."

The second variation of the model views organizational learning as a process that transforms inputs into outputs. Altman and Iles (1998) identified values of society and industry, physical goods and technology, and human and capital resources as inputs. These inputs are transformed into outputs such as flexibility, adaptation, survival, increasing capitals, and improving performance. Individual and team learning has mutual influence, so do team and organization. However, it is the leadership of the organization that mediates the function between organization and its members (Figure 4).

The third variation was proposed by Crossan, Lane, and White (1999) who also viewed OL as inputs-process-outputs. However, they incorporated March's (1991) theory on individual learning through exploration and exploitation. The authors proposed a 4I framework (i.e., intuiting, interpreting, integrating, and institutionalizing) in which they believed that individuals learn through their intuition and interpretation. Then they share their ideas with others in the integration process. Individuals' and teams' ideas are integrated and institutionalized in the organizations. The process is dynamic in that knowledge stocks flow forward from individual to group, group to organization, and individual to organization. At the same time, there is a reverse mechanism that feeds the information back to the individual and group (Figure 5). This idea was further developed



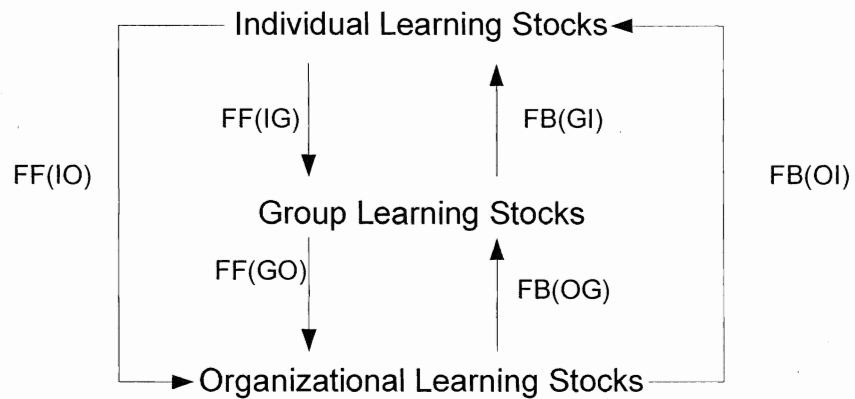
Inputs

Learning Process

Outputs

*Figure 4.* Altman and Iles's organizational learning model.

*Note:* From "Learning, leadership, teams: Corporate learning and organizational change," by Y. Altman and P. Iles, 1998. *Journal of Management Development*, Vol. 17, No. 1, p. 51. Copyright 1998 by MCB University Press. Reprinted with permission.



FF – feed forward

FB – feedback

IG – individual to group

GI – group to individual

GO – group to organization

OG – organization to group

IO – individual to organization

OI – organization to individual

*Figure 5.* The relationship of individual learning stocks, team learning stocks, and organizational learning stocks.

into stocks and flow of knowledge, and incorporated into a survey instrument (Bontis et al., 2002).

There are very few empirical quantitative investigations on the relationship models discussed above. Many of the quantitative research on OL focus on business competencies such as financial performance (Goh & Ryan, 2008; Jiang & Li, 2008; Murray, 2003; Payanides, 2007; Prieto & Revilla, 2006), marketing (Baker & Sinkula, 1999; Slater & Narver, 1995; Sujan et al., 1994), and product innovation (Calantone, et al., 2002; McKee, 1992). Goh and Richards (1997) developed a benchmark for learning organizations that comprise five components: (a) clarity of purpose and mission, (b) leadership commitment, (c) experimental and reward, (d) transfer of knowledge, and (e) teamwork and group problem solving. Their benchmark was later used in surveys to look for the relationship of individual, team, and organizational learning (Chan, 2003; Chan, Lim et al., 2003). Surprisingly, the results of their surveys do not support the relationship between individual learning and organizational learning. The investigators only found a moderate correlation of team learning with organizational learning (Chan, 2003).

#### Size and Organizational Learning

Regardless of size, Watkins (1996) argued that organizational learning requires individuals to take actions as well as having organizational support. Individuals must continue to make their investments in learning so they can develop knowledge and resilience for the change processes. They need to make inquiry, search for information, and take initiatives and push themselves outside their comfort zone, such as cross training in other divisions. As for organizations, they need to provide learning resources, provide training opportunities, and scan the environment for new opportunity. They have to

create a culture of safety, remove barriers, and become willing to share information with employees.

Organizational learning happens in all sizes and types of industries (Garcia-Morales, Llorens-Montes, & Verdu-Jover, 2007). Yet, large organizations have more resources and greater capacity to capture and exploit knowledge. They can allocate a substantial amount of budget to help their personnel develop skill. They have internal expertise that can promote and coach staff to improve their learning skills. The disadvantage of being large is the nested bureaucracy, which can slow learning process and change. One study in organizational learning shows that the larger the firm, the weaker the commitment to performance (Wu & Cavusgil, 2006). In a large company, there is less opportunity for staff to communicate and interact with employees in different departments. They do not develop common verbal and body language. These characteristics do not foster a trusting relationship, cultivation of shared values, and beliefs of the organizations (Judge, 2009). Dobrev, Kim, and Carroll's (2003) study on organization inertia and change indicated that the relative momentum of change decreased as the organization niche expanded.

The advantage of small organizations is the easiness of information flow due to the proximity of the key players. A study of employee perceptions toward culture as a promoter for organizational learning in small enterprises of five industries (i.e., construction, manufacturing, retail, food services, and healthcare) found that the healthcare industry has the strongest relationship with the learning dimension of organizational culture (Graham & Nafukho, 2007). The flattened structure eliminates the bottleneck that slows the flow of decision making. It is easier for employees in small



organizations to stop and discuss pressing work issues. Leaders in small organizations have to be aware that it is up to them to set the learning culture. Leaders need to assume a teaching responsibility to address critical issues so they can develop employees' capabilities to be new leaders. Tichy and Cohen (1999) confirmed that the best leaders were the best teachers. Leaders of hospitals in good knowledge sharing facilities directly get involved in hospital safety, and quality issues (Rangachari, 2008). A research showed that leadership has the strongest relationship with organizational culture (Nafukho, Garham, & Muyia, 2009). Wu and Cavusgil (2006) learned that the stronger the learning intention, the higher the commitment in an organization. Small hospital laboratories do not have in-house expertise and lack resources to stimulate and put good learning systems into practice. This is because training for new skills requires staff to be removed from their regular work duties, which have to be temporarily substituted by casual staff. Clinical diagnostics requires medical equipment and biological samples so learning needs to be done in a laboratory. Therefore, training in a working laboratory will interrupt and delay regular workflow. Training after work hours does not appeal to staff especially in the unionized environment. Anderson and Boocock (2002) studied learning in small organizations in Europe and found common issues such as budgetary constraints, and lack of in-house expertise.

### Dimensions of Organizational Learning

Although Senge's (1990) five disciplines are common dimensions in LO surveys, there is no consensus what OL constitutes. Goh and Richards (1997) identified five characteristics of OL: (a) clarity and mission, (b) leadership commitment, (c) experiment and rewards, (d) transfer of knowledge, and (e) teamwork. However, Chan (2003) could

not duplicate these dimensions with exploratory factor analysis. Spector and Davidson (2006) studied previous works of several scholars and suggested that organizational learning dimensions comprised goal formation process, leadership engagement, reflective activities, team processes, tolerance to errors and action that reflected information flow. These criteria contain many elements of Sinkula et al.'s (1997) survey instrument, which comprise three components: (a) commitment to learning, (b) open-mindedness, and (c) shared vision. Their instrument has been validated and used by several teams of researchers (Calantone et al., 2002b; Chan, Lim et al., 2003; Chang, 2007; Liao, 2006). Commitment to learning is the value that organizations hold toward learning. If top leaders do not believe in learning in the organization, learning will not occur. Managers in organizations need to believe that learning is the key to improvement, and help guarantee their firms' survival. They must view learning as an investment, not an expense that they have to reduce to improve the bottom line. Open-mindedness is related to Senge's (1990) mental model that leaders in organizations are willing to critique their own performance and listen to users on how to improve their products or services. This is not a simple thing to do as our own defensive routine prevents us from seeing ourselves in a bad way. We prefer to blame someone rather than ourselves (Argyris, 1991). Shared vision enables people to see the same goal and get them moving in the same direction. Hospitals are places that have conflicting goals and always require compromise in shared vision. Clinicians and medical staff want to put their best efforts to help patients, but usually encounter constraints from administrations on financial issues. Laboratory tests can show abnormal results that require further investigation but cannot always proceed because they are costly.

### Summary

There are three perspectives on OL: (a) normative, (b) development, and (c) capabilities. The normative perspective suggests that organizations only learn when they use specific skills and put effort into solving problems. By following the strict regimen, organizations can elevate themselves to a higher achievement level, the learning organization. The developmental perspective indicates that organizations learn through their stages of development in the organizational life cycle. The capability perspective believes that all organizations learn because learning is an ongoing natural process. Despite these differences, all three perspectives acknowledge that organizations learn through their individual members (Argyris & Schon, 1978; DiBella & Nevis; Senge et al., 1994). However, a number of quantitative and qualitative studies do not support this concept (Antonacopoulou, 2006; Chan, 2003; Chan, Lim et al., 2003).

There are four OL models that appear in the literature, and all of them incorporate individual learning, team learning, and OL into the relationship, with minor differences on the feedback loops (Altman & Iles, 1998; Bontis et al., 2002; Kim, 1993; Yeo, 2006). Kim 's theory is the most elaborative as it includes mental models (Senge, 1990), and single and double loop learning (Argyris & Schon, 1978).

## CHAPTER THREE: METHODOLOGY AND PROCEDURES

The relationship of the three levels of learning in the organization (i.e., individual learning, team learning, and OL) is still a subject of debate. There is literature that supports the concept that individual learning is not associated with OL (Antonacopoulou, 2006; Chan, 2003) as well as literature that shows contradictory outcomes (Yang et al., 2004). This research examined whether individual learning and team learning were associated with OL, using survey results from the managers and supervisors of hospital laboratories in Ontario. It investigated the relationship between:

1. Individual learning (independent variable) and team learning (dependent variable)
2. Team learning (independent variable) and organization learning (dependent variables)
3. Individual learning (independent variable) and organizational learning (dependent variables)
4. Organization type (independent variable) and organizational learning (dependent variables).

### Research Design

The questionnaire used in this research combines three survey instruments, which were previously developed and tested by three groups of researchers. The organizational learning construct in the questionnaire came from Baker and Sinkula (1999) who used their survey instrument to investigate the relationship between organizational learning, market orientation, and organizational performance. Their organizational learning construct had three components: (a) commitment to learning, (b) shared vision, and (c)

open-mindedness. Each component comprises six questions and the score of items in each section were totalled then averaged for statistical analysis. The individual learning variable was derived from Sujana et al. (1994) who developed a questionnaire for salespeople. The questions were modified to fit the OL research in an Australian hospital (Chan, 2003) and for-profit and not-for-profit organizations in Brunei. The team learning variable came from “Team Learning-Oriented Behaviour” of Table 18 in Edmondson’s (1996) doctoral dissertation. It had seven items that Edmondson validated and checked for consistency.

Participants in the survey answered the questions by ranking them on a Likert scale of 1 to 7 (strongly disagree to strongly agree) which was in the recommended range of 4 to 8 levels (Neuman, 2007). Scores from negative questions were reversed to the opposite scale. For example, scores from the shared vision’s question, “We do not have a well-defined vision for the entire business unit” was reversed, 7 became 1, 6 became 2, and 5 became 3. Those who answered 1, 2, and 3 on the question were reversed to 7, 6, and 5, respectively. Professors Harish Sujana, Amy Edmondson, and William E. Baker who developed these three previous questionnaires, have given me permission to use their instruments.

#### Site and Participant Selection

Regulation 964 of the Public Health Hospital Act classifies Ontario hospitals into 22 groups, depending on the size and type of treatment (Ontario Ministry of Health and Long-Term Care, 1990). In addition, the provincial government divides the health service institutes in Ontario into 14 Local Health Integration Networks (LHIN) based on population size and geographical locations (Ministry of Health and Long-Term Care,

2008). Among these 22 hospital groups, only two are considered as general hospitals with more than 100 beds. Hospitals in group A category are teaching hospitals, which consist of 14 institutes in Toronto, Hamilton, Ottawa, and London. Group B comprises 54 general community hospitals with more than 100 beds. Appendices D and E list the names of hospitals in these two categories. These were the only two groups of general hospitals that were used for the study. Other categories of hospitals were excluded because they did not perform a significant number of laboratory tests or they did not have a laboratory on their premises. These hospitals included small general hospitals (less than 100 beds), and institutes that were dedicated to rehabilitation, chronic care, and psychiatric treatment.

Since the formation of the LHIN and the accountability frameworks, hospitals in the same regions have started to consolidate their services. For example, a communication with a laboratory technologist of the Niagara Health System indicates that the organization has significantly reduced its laboratory service at Hotel Dieu Hospital and transferred the majority of the work to the St. Catharines General Hospital. The selection of the sample size is dependent on the size of the population, The researcher calculated sample size based on Yamane's (1964, p. 549) formula.

$$n = \frac{N}{1 + Ne^2}$$

Where  $n$  is the sample size,  $N$  population, and  $e$  probability or  $p$  value. Table 2 shows the size this study used for the two categories.

The majority of these hospital laboratories had an average of 6 supervisor personnel. This research originally expected to survey 366 (61 x 6) participants, but received 109 responses.

Table 2

*Population and Sample Sizes from the Two Hospital Categories*

Hospital Group	Population Size	Sample Size (p .05)
Group A- teaching hospitals	13	13
Group B – hospitals > 100 beds	54	48
Total	67	61

### Data Collection

After this research proposal received clearance from the Brock University Research Ethics Board (Appendix F), the investigator started to make contact with the hospital authorities through email and telephone. There was no uniform procedure in getting permission to conduct a survey in hospitals. Some hospitals expected the researcher to go through their hospital research ethics boards, while others referred the researcher to the laboratory directors or managers. And, yet, others only wanted the university ethics board to approve the research project prior to consideration. The laboratory managers, directors, or designated personnel of the participating hospitals received the questionnaire in bulk by mail. These people distributed the survey package with a letter of invitation and a self-addressed envelope to their colleagues and senior staff.

### Outline of Data Analysis

Data analysis began with data assessment for missing values, outliers, and data distribution, followed by statistical analysis, calculation of statistical power, and validation of results. The procedures for outliers and normality were iterative, and there were two levels of investigation. The first level examined the outliers and normality of individual items from the responses. The second level looked at the normality and outliers of summated scales. The linear regression was the simplest analysis as it only required univariate outlier and normality rules. The most complex was multivariate analysis of variance (MANOVA) as its assumptions required the researchers to ascertain that outliers and normality followed the rules at group level. There were two groups in this study, teaching hospitals and community hospitals. Each statistical procedure also



had its own technique of computation for statistical powers. Linear regression and MANOVA power analyses are readily available through computer software, but set correlation (SETCOR) must be manually calculated and then its value matched with the power table. The analysis results were validated with the bootstrap techniques which replicated 1,000 times with conventional statistical methods using the same sample sizes. Figure 6 presents the investigation process that indicates which statistical procedures answer the research questions.

### Data Assessment

All data were electronically stored in the computer using the Statistical Package for Social Science (SPSS)<sup>TM</sup> and SYSTAT<sup>TM</sup>. The returned surveys were reviewed, assigned a number, and kept in a safely locked cabinet, with only the researcher having access to them. The data analysis started with the scanning procedures for missing values, outliers, and normality. Missing values, outliers, skewness, and kurtosis should be discovered during data screening. Except for missing value analysis, the screening procedure for outliers, skewness, and kurtosis were iterative. Figure 7 shows an iterative process that I used in this study for univariate and multivariate data screening. The first step assessed missing values and outliers of the 34 items in the questionnaire using Extreme Studentized Deviate (to be discussed in the outlier detection section). The second step reviewed the normality using Shapiro-Wilks, skewness/standard error and kurtosis/standard error. Variables that failed the normality test were transformed and rechecked. Normal variables proceeded to the next step for univariate statistical analysis

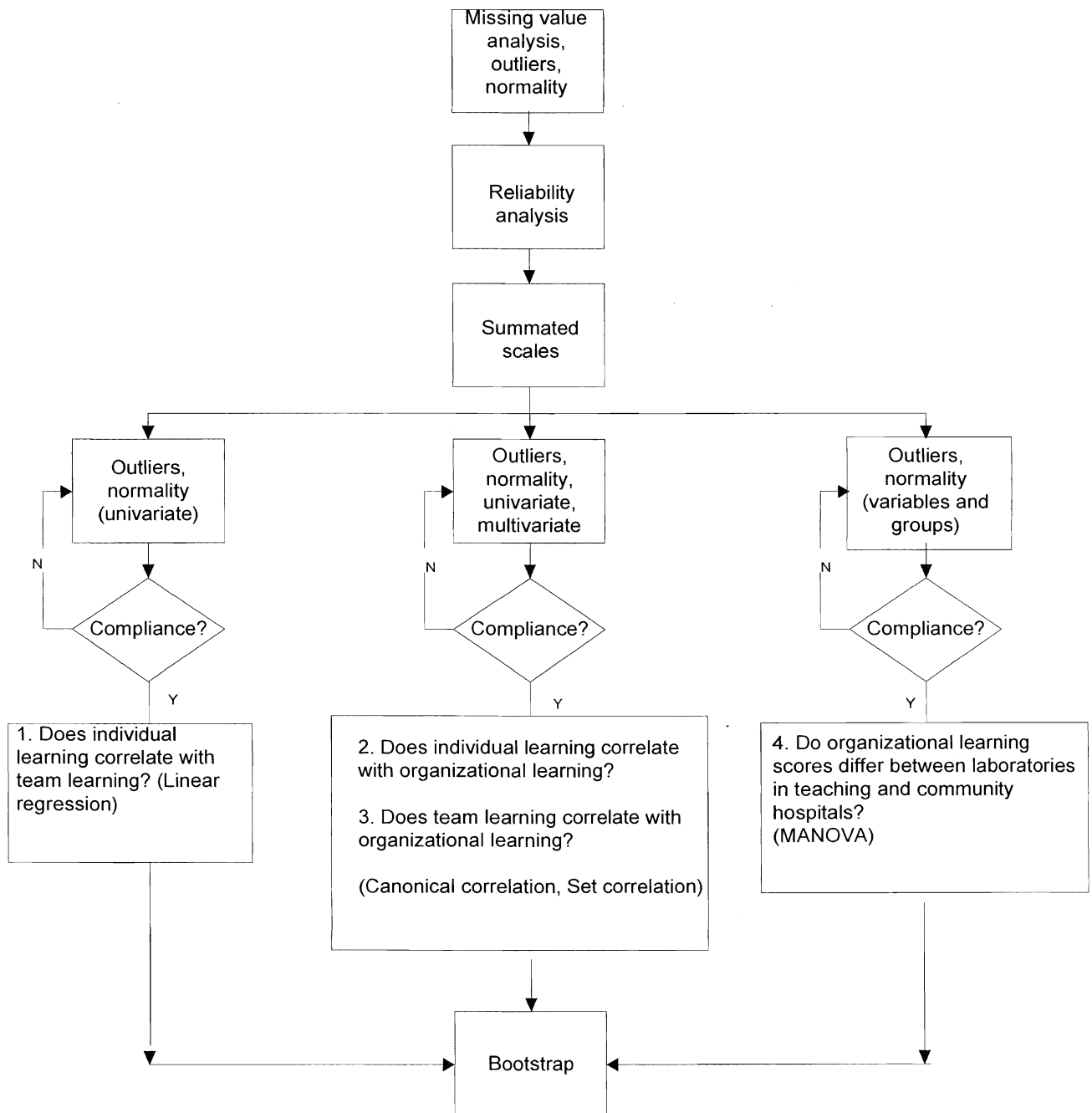


Figure 6. Investigation diagram of the research questions.

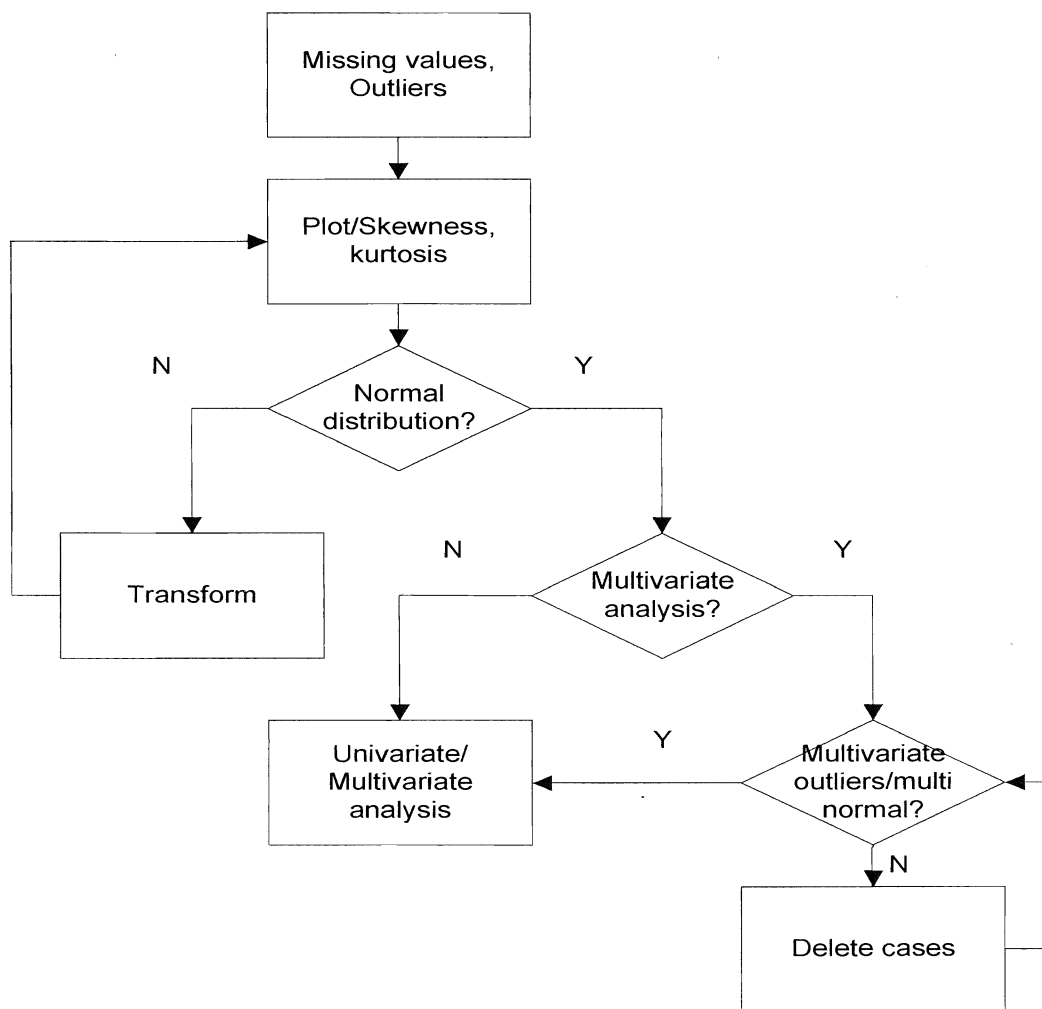


Figure 7. Flow diagram for data assessment.

or for checking of multivariate outliers. If the result showed multivariate outliers, the cases were deleted prior to the calculation of multivariate normality (Henze-Zirkler procedure).

### Statistical Power

A statistical decision is dependent on the rejection of the null hypothesis, which is usually based on the probability of 5% ( $\alpha .05$ ). The risk of making an incorrect decision by rejecting the null hypothesis is called type I error. By lowering the value of  $\alpha$  level below .05 (for instance  $\alpha .01$ ) researchers can reduce the chance of making type I errors. Although it seems reasonable to lower the chance of making a type I error, researchers could end up accepting the null hypothesis when it is false (type II error). This is the trade off that researchers have to consider when making statistical decisions. One way of dealing with this possible occurrence of type I or type II errors is to use power analysis of effect size. Creswell (2008) defines effect size as “a means for identifying the strength of the conclusions about group differences or about the relationship among variables” (p. 639). The determination of effect size differs for different statistical tests, but according to Cohen (1996, p. 300), effect size or power of 0.8 is the most reasonable compromise for the balance of type I and type II error possibilities. This study determined effect size for linear regression and MANOVA using statistical software –PASS<sup>TM</sup>. The effect size for SETCOR is manually calculated as suggested by Cohen (1988, pp. 467-530). There has been no statistical software or methods that can determine effect size for canonical correlation.

### Missing Values Analysis

Respondents do not always give complete answers in a survey, either intentionally or unintentionally. Reasons as to why respondents do not answer the questions are a lack of knowledge, unclear questions, and refusal to reveal their personal information. Respondents can rush through the questionnaire and unintentionally miss some questions. Data recorded in this survey were investigated with SPSS missing value analysis for the extent, randomness, and missing patterns as recommended by Hair, Black, Babin, Anderson, and Tatham (2006). Cases with excessive numbers of missing values would be deleted from the analysis. I closely scrutinized two types of missing patterns: missing at random (MAR) and missing completely at random (MCAR). The MAR type of missing values happens when the value of Y depends on X. For example, in a survey that asks respondents about gender (X) and household income (Y), MAR would have more missing values from females than males. MCAR missing values occur at the same frequency among male and female respondents. The remedy for the MAR type requires maximum likelihood estimation techniques such as means, standard deviation, and correlation. MCAR issues can be addressed by eliminating cases with missing values. However, the sample size may prevent researchers from adopting this technique, and they will have to use replacement values based on mean substitution or regression imputation.

### Detection of Outliers

Quite often, survey data show a few values that appear to be inconsistent with the majority. Unless these data can be legitimately proved as outliers, they should be kept in the analysis (Hair, Anderson, Tatham, & Black, 1998). Outliers arise from four reasons. First, they are the results of the procedural errors such as data entry errors. Second,

special events can lead to unusual observations. For instance, an employee satisfaction survey in a school that just makes a layoff announcement would be invalid, unless it is a common event in the education system. The third type of outliers is the extraordinary observations that have no explanation. The last type of outliers is multivariate outliers. They are data that appear normal individually, but, yet, are unique when combined with others. The data analysis investigated two levels of outliers, univariate and multivariate.

#### *Univariate Outliers*

There are many statistical techniques that identify univariate outliers (Barnett & Lewis, 1998). Many statistical software packages provide users with a graphical display, boxplot, which is based on the inter quartile range. The boxplot display in SPSS comprises the box and whiskers- vertical lines extend up and down from each end of the box. The box itself has values in the range of 25 to 75 percentiles, with a cross section line at 50 percentile. The top and the bottom whiskers show the range of values that fall within 1.5 box-lengths from 75 and 25 percentile, respectively. Any values outside these whiskers are considered outliers. SPSS uses “0” and “\*” to represent minor and major (3 box lengths from 25 or 75 percentiles) outliers. Because of its availability in statistical software, the boxplot has become the popular test for outliers (Frigge, Hoaglin, & Iglewicz, 1989). However, Hubert and Vandervieren (2008) pointed out that skewed data are often erroneously declared outliers by the boxplot method. The authors illustrated this error by using a coal mining disaster set of data in which the boxplot rejected 6.84% of the observation points. Barnett and Cohen (2000) also showed that boxplot overestimated the number of outliers in lifetime data.

In addition to boxplot, investigators can apply GRUBB's test, also known as the "Extreme Studentized Deviate" (ESD) to identify outliers in their survey data (Rosner, 1995, pp. 277-284). This is the method that I used in this study. Raw data of all items in the questionnaire were standardized into z-scores and compared to those in the table in the textbook (Rosner, p. 656). Cases with z-score values above  $\pm 3.38$  that occur more than once were excluded from the analysis (Hair et al., 2006, p. 75).

### *Multivariate Outliers*

The univariate outlier is adequate for statistical analysis with two variables, but it cannot detect multivariate outliers. This is similar to viewing the mountain from a distance which observers can see as a bell shape. However, they do not know whether the mountain is symmetrical since they cannot see the ridge behind it. To be able to make a true judgment, observers have to stand on top of the mountain and look around in all directions. In statistics, it requires the type of measurement known as Mahalanobis distance (MD). This technique measures the distance of each case from the centroid (Tabachnick & Fidell, 1996), and the ratio of MD over degree of freedom (df) is approximated to Chi square distribution. Tabachnick and Fidell recommended a p-value of 0.001 as a significant measurement.

Cases with multivariate outliers are normally deleted if researchers know that the number of remaining cases do not compromise the integrity of the statistical analysis. However, researchers may have to keep these outlier cases when their sample size does not justify deletion. In this situation they will have to keep note and interpret their results with caution.

### Normality Tests

Normal distribution also exhibits itself both at the univariate and the multivariate levels. The univariate statistics measure each variable to see whether it meets the normal distribution requirement. Several well-known methods, such as Kolmogorov-Smirnov and Shapiro-Wilks, are available in most statistical software such as SPSS<sup>TM</sup> and SYSTAT<sup>TM</sup>. Another technique that researchers can use to measure the normality of their data is by using the  $Z_{\text{skewness}}$  and  $Z_{\text{kurtosis}}$ , which are the ratios of their skewness and kurtosis to their corresponding standard errors. A calculated value exceeding  $\pm 2.58$  violates the normality assumption at the 0.01 probability level (Hair et al., 1998). George and Mallery (2007, p. 99) suggested that researchers can just look at the skewness and kurtosis values. "As with kurtosis, a skewness value between  $\pm 1.0$  is considered excellent for most psychometric purposes, but a value between  $\pm 2.0$  are in many cases also acceptable" (p. 99).

Data that exhibit symmetric distribution are not necessarily a normal distribution, as its shape can assume different degree of flatness. The shape of the peak is defined by the term kurtosis, which indicates the degree of tallness or flatness of the graph.

There are three techniques that researchers can use to deal with data that do not show a normal distribution. First, data can be transformed into a logarithmic, parabolic, and cubic format. However, prior to the transformation, researchers must investigate its skewness. Data with left skew require reflection before the transformation. This is achievable by subtracting the responded values from one number above the maximum range prior to conversion. For example, if the survey asked respondents to rank their answers from 1 to 7, and data are negatively skewed, researchers will have to subtract the



answered valued from 8 prior to converting them into a logarithmic format. Second, researchers can use nonparametric statistical techniques to analyze their data. However, many of the multivariate statistics use normal distribution assumptions and researchers may have no choice but to use the next option. The last technique is a bootstrap or jackknife, which is based on the repeating draw of the subsample for multiple times with a replacement in the former or nonreplacement in the latter. There are many studies in literature that showed that bootstrap results with a smaller size of samples yielded similar conclusions as a conventional technique with much larger sample sizes (Efron & Tibshirani, 1993; Leger, Politis, & Romano, 1992; Stine, 1989; Taylor, 2005).

Although univariate variables display normality, researchers cannot assume that their data have multivariate normal distribution. However, if a variable is multivariate normal, it is also univariate normal (Hair et al., 1998). Thus, a panel of variables should have multivariate normal distribution tested prior to specific statistical procedures. This is the area that has not been well addressed in social sciences research literature. Research textbooks, such as *Social Research Methods* (Neuman, 2006) and *Educational Research* (Creswell, 2008), do not mention multivariate normal distribution, even though at least 50 procedures exist (Mecklin & Mundfrom, 2003). Mecklin and Mundfrom compared 13 multivariate normality tests by using MonteCarlo simulation to generate 10,000 data sets for many types of multivariate distributions. They recommended the Henze-Zirkler procedure as a formal test of the null hypothesis of multivariate normality when readers wanted to rely on one multivariate normality procedure. This thesis, however, included Mardia skewness and Mardia kurtosis as an addition to Henze-Zirkler procedure, since they were readily available in SYSTAT.

### Homoscedasticity

Homoscedasticity indicates that variables have relatively equal variances (Hair et al., 1998). This term is also known as homogeneity of variance in univariate statistics. The concept of homoscedasticity applies to both dependent and independent variables. In linear regression, the variables of dependent and independent variables should have variances relatively within the same range. In analysis of variance and MANOVA, the homoscedasticity only implies that the dependent variables have relatively the same variance. There are two common methods to test this assumption, Box's M and Levine's test. Hair et al. (1998) suggest that most of the heteroscedasticity comes from skewed distribution, and it can be corrected by data transformation.

### Statistical Procedures

Following missing value analysis, outlier scan and normality tests, data were ready for statistical analysis. This study utilized multiple statistical procedures: descriptive statistics, t-test, reliability test, linear correlation, canonical correlation analysis, SETCOR, and MANOVA.

### *Dependent and Independent Variables*

This study used Kim's (1993) framework on the linkages of individual and organizational learning. Kim stated that "Clearly, an organization learns through its individual members and, therefore, is affected directly or indirectly by individual learning" (p. 41). This statement suggested that individual learning is an independent variable and organizational learning is the dependent variable. In the same article, the author also stated that:

However, if we view a group as a mini-organization whose members contribute to the group's shared mental model, then the model can represent group learning as well as organizational learning. A group can then be viewed as a collective individual, with its own set of mental models that contributes to the organization's shared mental models and learning. (p. 43)

The above paragraph suggests that individual learning affects team learning. Therefore, individual is an independent variable and team learning is a dependent variable. Likewise, between team learning and organizational learning, team learning must be treated as an independent variable.

#### *Descriptive Statistics*

Descriptive statistics in this study involve means, standard deviation (SD), skewness, kurtosis, maximum, and minimum. It is the first line of analysis that gives researchers an insight into the characteristics of the data so they can strategize for the following steps in the analysis. Mean is the average value of the data, and standard deviation is the spread of the values around the mean. When the data are normally distributed, data exhibit a bell shape. In some occasions, samples may be bimodal, where the distribution of data shows two equal peaks. This shape indicates that there are two distinct subgroups.

The study used descriptive statistics to display the distribution of responses on the 23 items in the sections of individual learning, team learning, and organizational learning which comprised open-mindedness, commitment to learning, and shared vision.

*T-test*

One of the common univariate statistics that has been used for comparison of group means is t-test. T-test measures the difference in mean values of two groups. In this study t-test is applicable in the comparison of individual learning and team learning between laboratories in teaching hospitals and community hospitals. There are three assumptions of the t-test for two independent variables (B. Cohen, 1996).

1. Independent random sampling. That means data of both groups are random samples. This study tried to ensure that samples were representative of the 14 LHINS. However, because the survey was anonymous and voluntary, it was not possible to verify this assumption.
2. Normal distribution. As mentioned earlier, the remedy for nonnormal distribution is to use a transformation into a different data format. Because the average values of individual learning and team learning were not normally distributed, this study had to transform data into logarithmic and square root formats.
3. Homogeneity of variance. Prior to the decision to perform t-test, researchers need to investigate the variances of the two groups. The pooled-variances t-test is utilized when the samples of the two groups are roughly equal. When the variances are not equal, researchers must apply a separate-variances t-test. This study utilized both equal and nonequal variances t-test.

Relating to the t-test is the analysis of variance (ANOVA), which measures the difference of mean values when there are more than two groups.

### *Reliability Test*

As several investigators had tested the validity of the organizational learning construct (Chan, Lim et al., 2003; Chang, 2007; Liao, 2006; Sinkula et al., 1997), this study only applied the reliability test to the data. Items that led to an overall Cronbach's alpha values below 0.7 were dropped out of the next level of analysis.

There are several techniques to check the consistency of items in a construct. Some of these techniques are as follows. Split half is applicable when the researchers want to test whether multiple items measure the same construct. The items are randomly split into two parts and their correlations are compared for their consistency. Another application of split half is to use two sets of questionnaires that measure the same construct on the same group of people (George & Mallery, 2007; SPSS, 1999). Strict parallel technique assumes that scored items have the same means and variance. Parallel method hypothesises that items have the same variance but not the same means. Cronbach's alpha measures the lower bound of the reliability in the survey items.

None of the above methods provide a perfect measure for internal consistency. A construct with a small number of items (7 or below) could produce a high Cronbach's alpha value (Grayson, 2004). In this study, I used a series of diagnostic measures to assess the internal consistency (Hair et al., 2006).

1. The construct should have significant numbers of inter-item correlations that exceed .30
2. The item-to-total correlation must exceed 0.5
3. Cronbach's alpha must have a value greater than 0.7

### *Summated Scales*

Items from each variable were combined after they had been measured in the reliability test using the mentioned criteria. The summated scale was a composite measure, which in this study used the average of score from items in each variable. Therefore, each case of the data would have five summated scales; namely, individual learning, team learning, open-mindedness, commitment to learning, and shared vision. These summated scales were the starting points of statistical investigations for t-test, curve estimation, linear regression, canonical analysis, SETCOR, and MANOVA.

### *Ordinary Linear Regression*

Investigation of the relationship between individual learning and team learning was a univariate statistical analysis, using the summated scales of the two constructs. The analysis began with a scatter plot to explore the type of relationship between individual and team learning, which could be a linear, quadratic, and cubic regression model. It proceeded with the visual inspection of the scatter plot and followed by the analysis on one of the three models: linear, quadratic, and cubic model.

The linear equation has the formula  $TL = \alpha + \beta (IL)$ , quadratic equation is  $TL = \alpha + \beta (IL) + \gamma (IL)^2$ , and cubic model  $TL = \alpha + \beta (IL) + \gamma (IL)^2 + \lambda(IL)^3$ . Where  $\alpha$  is the intersect and  $\beta, \gamma, \lambda$  are constants of the equation. IL and TL are individual learning and team learning.

The decision to adopt a model for final analysis was based on the parsimonious assumption and  $R^2$  value. The linear model was selected in this study because the scatter plot and curve estimate did not suggest any improvement in  $R^2$  of the other two models.

### *Canonical Correlation Analysis*

As mentioned in the variable section, both IL and TL are independent variables, while organizational learning, which comprises three components, is the dependent variable. Although IL and TL have their own individual effect on organizational learning, it is also possible that the two independent variables can have a combined effect. This type of investigation requires a statistical procedure that simultaneously investigates the relationship of two independent variables and multiple dependent variables. Canonical correlation analysis (CCA) is one of the few techniques in multivariate data analysis that enable investigators to study the relationship of two variable sets. Hair et al. (1998) stated that “in situation with multiple dependent and independent variables, canonical correlation is the most appropriate and powerful multivariate technique” (p. 444). In this study, the relationship between the dependent variable set and independent variable set can be written in general and specific forms as

$$Y_1 + Y_2 + Y_3 = X_1 + X_2$$

$$aCL + bOM + cSV = dIL + eTL$$

Where a, b, c, d, and e are coefficient values of variables. CL, OM, and SV are variables in the dependent set, and IL and TL are variables in the independent set. These variables represent commitment to learning, open-mindedness, shared vision, individual learning, and team learning, respectively.

The schematic diagram of the investigation is represented in Figure 8. The canonical procedure generates the maximum number of equations (functions) equal to the number of variables in the smaller set. Therefore, in this study the procedure only produced two equations because the independent set was smaller. The canonical

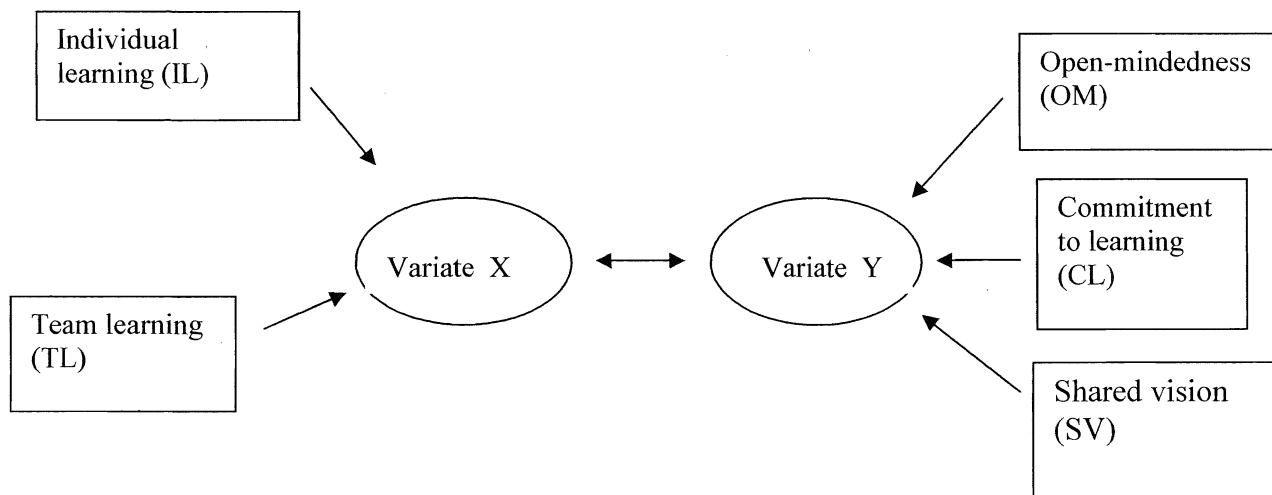


Figure 8. Canonical relationship of two variable sets.



correlation analysis develops the equation by forming pairs of variates, which are linear combination of variables of each side of the equation. In this case variate X is a linear combination of IL and TL, and variate Y is a combination of OM, CL, and SV.

The first step in the canonical analysis is the assessment of canonical correlation ( $R_c$ ), which is a square root of eigenvalue. An eigenvalue is an estimate of a shared variance of dependent and independent variables. The procedure extracts the eigenvalue from all existing bivariate correlations. Because this study had five variables ((i.e., IL, TL, OM, CL, and SV), there were 10 bivariate correlations. The canonical procedure reduced these 10 correlations to two eigenvalues. The number of eigenvalues was identical to the number of variables in the smaller set. Only the  $R_c$  that had  $p \leq .05$  was significant, and required further assessment, which included canonical coefficient, standardized coefficient (canonical weight), canonical loading, and cross-loading.

Canonical coefficient is comparable to the raw coefficients value in multiple regressions. Variables with the same signs indicate a direct relationship while the opposite signs indicate a reverse direction. The magnitudes in canonical weight explain the amount of contribution of the variables in the variates, the larger the weight, the greater the contribution.

Many scholars suggest that canonical weight is unstable and recommended canonical loading as an alternative (Lambert & Durand, 1975; Tacq, 1997; Thompson, 1984). Canonical loading, the correlation of variables to its variate, has the same concept as factor loading. A canonical loading square value is the shared variances between the variable and the variate.

Cross loading is the correlation of independent variables to the dependent variate

and likewise the correlation of dependent variables to the independent variate. Cross loading is more conservative and less inflated than canonical loading (Dillon & Goldstein, 1984). Cross loading, however, does not specify which variables (IL, TL) on the independent set correlate with variables on the dependent set (OM, CL, SV). Because of this limitation, the canonical correlation does not provide a complete answer to investigators. To overcome this inadequacy, I selected a related technique called set correlation (SETCOR) to study the relationship of individual variables of the two sets.

There are two important assumptions in canonical correlation analysis (Hair et al., 1998). First, the correlation between any two variables is a linear relationship. Second, canonical correlation is also a linear relationship between two variates. Canonical analysis does not require strict assumption of normality. However, Hair et al. (1998) recommend that all variables be evaluated for and transformed to normal distribution if necessary.

### *Set Correlation*

Before delving into SETCOR, it is imperative that researchers need to understand the correlations in a condition that has one dependent variable and multiple independent variables. There are two methods to describe their association: partial and semipartial correlations. The differences between these two types of correlations can be easily understood by using a ballantine as a representation of areas in an investigation. For example, the three circles are variables Y,  $X_1$  and  $X_2$ , having overlapped areas labelled as a, b, and c (Figure 9). The correlation of Y with  $X_1$  and  $X_2$  encompasses the areas  $a + b + c$ , Y with  $X_1$  cover areas  $a + b$ , and Y with  $X_2$  is  $b + c$ .

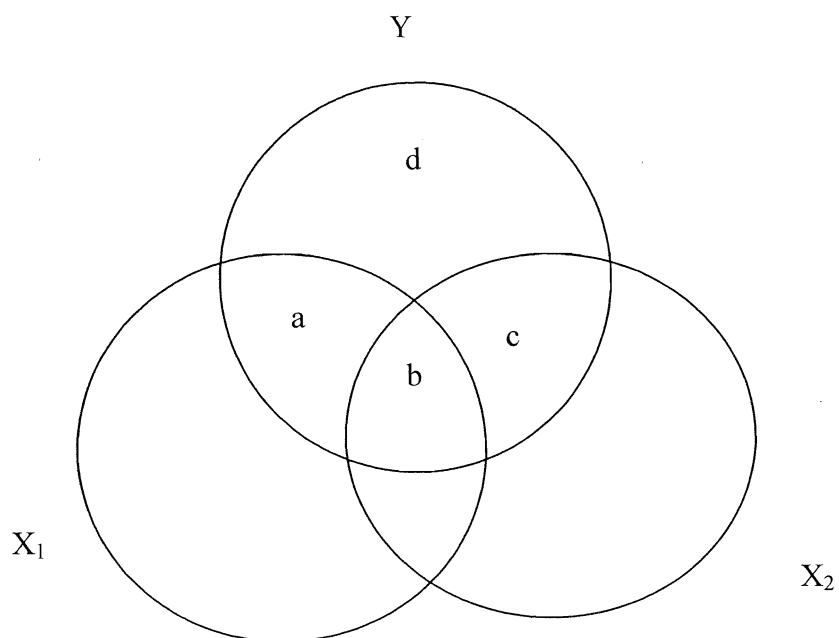


Figure 9. The ballantine for  $Y$ ,  $X_1$ , and  $X_2$ .

The square of semipartial correlation ( $sr_1^2$ ) of Y and  $X_1$  will only incorporate area a, excluding the area b. Similarly, the square of semipartial correlation ( $sr_2^2$ ) of Y and  $X_2$  only includes area c. However, the described semipartial correlations are not applicable to a situation with multiple dependent and independent variables, even though they have the same concepts. When there are multiple dependent and independent variables, the solution requires the SETCOR procedure.

The SETCOR technique allows researchers to investigate five types of associations. Table 3 uses A, B, C, D, E, and F to represent variables in a study. The variables following the period (.) are excluded from the study sets. For example, in the bi-partial study (procedure 1), variable E is excluded from set Y, and variable A is excluded from set X. The semipartial refers to either set X or set Y that excludes one variable (procedures 2 and 3). In the partial correlation study, the identical variable F is excluded from both sets (procedure 4). Procedure 5 does not exclude any variable from the study.

The above procedures enable researchers to investigate the relationship of social constructs and their components. For example, which one of the three components (open-mindedness, commitment to learning, and shared vision) of the organizational learning correlates with individual learning or team learning?

SETCOR is a derivative of the CCA procedure. Cohen (1982) reprinted in Cohen and Cohen (1983) introduced this technique to overcome some of the issues in canonical analysis. First, canonical analysis produces more than a single correlation but the significant statistical test can only measure one at a time. Second, canonical weights are

Table 3

*Five Types of Association Between Set X and Set Y*

Procedure	Type	Set Y	Set X
1	Bipartial	D,C,E	B,A
2	Semipartial	D,C,E	B,A
3	Semipartial	D,C,E	B,A
4	Partial	D,C,E,F	B,A,F
5	Whole	D,C,E	B,A

not stable due to the calculation that aims to optimize the canonical correlation. The relationship of SETCOR and canonical correlation is

$$R_{y,x}^2 = 1 - (1 - R_{c1}^2)(1 - R_{c2}^2)(1 - R_{c3}^2) \dots \dots \dots (1 - R_{cn}^2), \text{ where}$$

$R_c^2$  is the correlation of CCA and  $R_{y,x}^2$  the coefficient of determination of SETCOR.

There are only a few articles in the literature that employ SETCOR for social research. As of September 1, 2009 databases, such as Education Administration abstract, ERIC@ Scholar Portals, and Educators Collection, showed no articles that employed set correlation. ABI/Global listed five articles, four in business and one in statistics. Web of Science listed 63 articles that utilized set correlation as a method of investigation. Among these, only eight articles were in the field of social sciences: two in operations research, three in psychology, and one each for group dynamics, economics, and education. The majority of articles were related to chemistry, botany, physics, medicine, computer, and statistics. Academic Search Premier showed 26 articles, and only one of these is in education, 5 in statistical context (2 written by Cohen himself) and the rest are in sciences. The same education article that used SETCOR also showed up in the Education Research Complete database. This lack of interest in the method may come from the fact that the procedure is relatively new and popular statistical software, such as SPSS, SAS, Statistica and MINITAB, do not offer it in their packages. SYSTAT and BMDP are the two statistical software packages that provide users with SETCOR. Schutte and Malouff (2004) used SETCOR to investigate the relationship of personality dimensions to reading preferences among university students. Vastag and Montabon (2001) used the same technique to study the effect of the combination of manufacturing program and delivery services on inventory levels and structure. Lebsack (1995) investigated gender

discrimination in faculty salary patterns in small colleges, with a combination of SETCOR, canonical analyses, multiple regression, and multiple discriminant. SETCOR has an advantage over canonical correlation, as it allows researchers to make a direct investigation of partial, semipartial, and bipartial associations between the dependent and independent sets.

Using the bipartial procedure, I investigated the relationship between commitment to learning (CL) and individual learning (IL), removing open-mindedness (OM) and shared vision (SV) from CL, and team learning (TL) from IL. Following the same technique, I investigated the relationship between OM and SV to IL and TL.

The overall process of the investigation for the relationship between individual learning, team learning, and organizational learning was the following three-step technique.

1. IL and TL were considered as an independent set. The relationship of this set with organizational learning, which comprised three components – OM, CL and SV- was studied with SETCOR and CCA with procedure 5 of Table 3
2. The relationship between organizational learning and each variable of the independent set were studied with SETCOR. The individual learning was first entered into the equation, followed by team learning. This is procedure 2 and 3 of Table 3
3. The last step was to look at the unique components of both independent and dependent sets. This is procedure 1 of Table 3.

The three-step procedure gives a picture of association among unique components of the five variables, which enables this thesis to answer questions 2 and 3; whether

individual learning correlates with organizational learning, and whether team learning correlates with organizational learning.

### *Multivariate Analysis of Variance (MANOVA)*

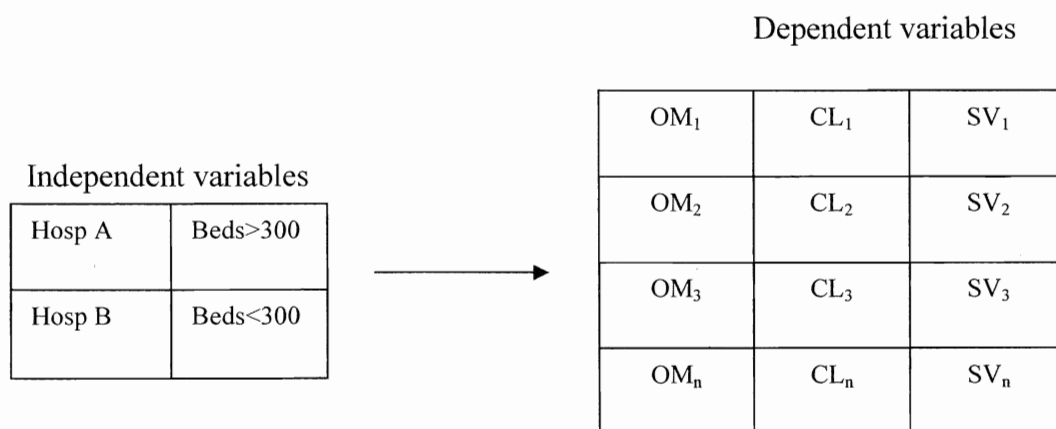
MANOVA is applicable in a situation where the dependent variables are in metric, but the independent variables are categories. In this study, there were three dependent variables (OM, CL, SV) and two independent variables: hospital type (teaching, community) and bed size (100-300 and >300). Figure 10 shows the possible relationship of dependent and independent variables.

To find out whether the difference between two groups of an independent variable is significant, MANOVA calculates Wilks' lambda from two matrices **[W]** and **[B]**. **[W]** is the within-groups multivariate dispersion matrix, and **[B]** is the between-groups multivariate dispersion matrix. The ratio of  $\frac{[W]}{[W] + [B]}$  is Wilks' lambda, which is a measure of overall difference between the two groups.

The above illustration shows two-way MANOVA (with two independent variables), but the calculation also applies to one-way MANOVA (with one independent variable).

There are multitudes of criteria in making MANOVA interpretations (Hair et al, 1998). First, respondents must independently answer the questions. No consensus decision should be allowed to answer survey questions. Second, all dependent variables should be multivariate normal. Third, variables must show homoscedasticity. Fourth, there is a statistical significance for Barlett's test of sphericity. This test tells the researchers that there is an adequate intercorrelation among variables. Fifth, Lavene's test shows equal spreads among variables. Sixth, the sample size in each cell is greater





*Figure 10.* Relationship of the variables in multivariate analysis of variance.

than the number of variables. However, the recommended sample size of each cell is 20. Because this investigation had a cell size that is less than 20, it only studied the differences in organizational learning between laboratories in teaching and community hospitals.

### Validation of the Results

Multivariate data analysis enables researchers to discover complex relationships among variables. Yet, it is difficult to know whether the results will hold true for the general population. Hair et al. (2006, p. 25) advised researchers to put in all efforts to validate their results with the following three procedures.

1. Split the samples and use one subsample to estimate the model, while keeping the other half for validation.
2. Collect a new set of data from different subjects of the same population.
3. Use bootstrap to draw random subsamples from the same data set. Depending on the capability of the computer, researchers can draw subsamples 1,000 or 2,000 times. Estimate the interested parameters and calculate their expected ranges. This approach does not rely on statistical assumptions such as normality.

The sample size in this study was not large enough to split data into two subsamples, specifically for canonical analysis and MANOVA. It would take extra amounts of effort, time, and expense to recruit more participants. Mooney and Duval (1993) agreed on the legitimate use of bootstrap to check the model assumption in conjunction with parametric inference. It was to ensure that the possible assumption

violations had not adversely affected the parametric inference. This was how the bootstrap was employed in this study.

Bootstrap is one type of simulation technique in which samples are redrawn with replacement for a specific number of times. The technique became popular after Efron and Tibshirani (1993) introduced it in the late 1980s. Several works have been published in the literature on various comparable statistical results between bootstraps and those with the normal distribution assumptions (Leger et al., 1992; Taylor, 2005; Thomson, 1995).

In linear regression, Thompson (1994) illustrated the usefulness of the bootstrap technique by comparing three validation methods (i.e., cross validation, jackknife, and bootstrap). Thompson showed that the 95% confidence interval of the bootstrap results were similar to those for cross-validation analysis.

In an attempt to explore the replicability of bootstrap results, Thompson (1995) selected a sample of 301 subjects. The author used this sample to study the correlation of general verbal ability and paragraph comprehension, with four predictor variables: speeded dot computing, speeded dot discrimination, and speeded discrimination of straight and curved capitals. Because there were multiple dependent and independent variables, CCA was the method of choice. From the sample of 301, Thompson (1995) used the computer to randomly select 50 subjects and performed CCA and received canonical correlation (C) value of 0.357. He repeated this process 1,000 times by letting the computer randomly select 50 subsamples from the same subjects. He learned that the CCA had a mean value of 0.237 and standard deviation of 0.117. Comparing these two values ( $C = .237$  and  $.357$ ) with that of the sample ( $C = 0.299$ ), one can see that both

values missed the target population by about 20%. The bootstrap underestimated the target value by 20.7%, and the conventional method overestimated by 19.4%. These results suggest that although bootstrap does not yield a satisfactory result, its performance is not worse than the conventional method that relies on a single set of sample. As Thompson (1995) noted “the business of science is formulating generalizable insight. No one study, taken singly, establishes the basis for such insight” (p. 92).

This thesis used bootstrap with 1,000 replications to validate the results from conventional statistic tests for linear regression, canonical correlation analysis, and MANOVA. This is the minimum amount of resampling that Stine (1989) suggested for researchers who use a bootstrap technique for estimation of a percentile of distribution. Bootstrap calculation is achievable with SYSTAT, which gives summary results of slope ( $\beta_0$ ) and intersect ( $\beta_1$ ) in linear regression. The program, however, does not generate summary statistics for canonical correlation and Wilks' lambda in MANOVA; therefore, syntax commands are written to capture these parameters.

### Ethical Consideration

This survey was voluntary; therefore, the participant could refuse to answer any questions. The survey did not ask respondents about personal demographic questions such as age, religion, or political opinion. Respondents did not have to identify themselves or their workplaces. No names, addresses, signatures, or initials were required in the survey. The questions in the survey were straightforward and posed no psychological or social risks to the respondents.

The invitation letter accompanying the survey clearly indicated to the participants that they could decline to participate at any time without penalty. It also stated that by

submitting the answer, respondents indicated that they had been fully informed about this research and voluntarily agreed to participate. It advised the respondents to retain the copy of the invitation letter for their record. Moreover, the invitation letter gave the phone number and email address of the Brock University Research Ethics Board for respondents who had concerns, comments, or issues with this survey.

The researcher did not ask for informed consent since the survey was anonymous. Participants were educated adults, and the research did not require observation, audio or video taping, biological specimen, or physical contact. However, the researcher approached organizations and requested permission to conduct this research survey. Only organizations that gave permission received a questionnaire.

Answers to the survey were a personal point of view; thus, confidentiality was the most important ethical concern in this study. This researcher expected to receive some of the returned surveys through fax machines; this could lead to respondents dialling a wrong number. Paper could be lying around and viewed by participants' subordinates or supervisors who might disagree with the answers, creating conflict in the organization. Although the survey did not require the identification of participants, the fax machine usually indicated the phone number of the sender.

## CHAPTER FOUR: DATA ANALYSIS AND FINDINGS

The multivariate data analysis presents itself with a much more complex issue than the univariate data analysis. Researchers are not only confronted with the outliers and normality of each variable, but also need to consider normality and outliers when the variables are combined into a set. The missing values also pose a challenge to investigators. Too many missing values in the same variable can make the analysis invalid. The data analysis in this study proceeded as explained in Chapter Three. It began with data assessment, which included participant profiles, missing values, outliers and normality tests, both univariate and multivariate levels. The reliability tests assessed the sets to ensure that they passed the threshold, Cronbach's alpha of 0.7. The chapter used five types of statistical analysis (i.e., t-test, linear regression, canonical analysis, set correlation, and MANOVA) to answer the research questions.

### Data Assessment

Data assessment in this section reports participant profiles, missing value analysis, univariate, and multivariate outliers, and normality of the survey items.

#### *Participant Profiles*

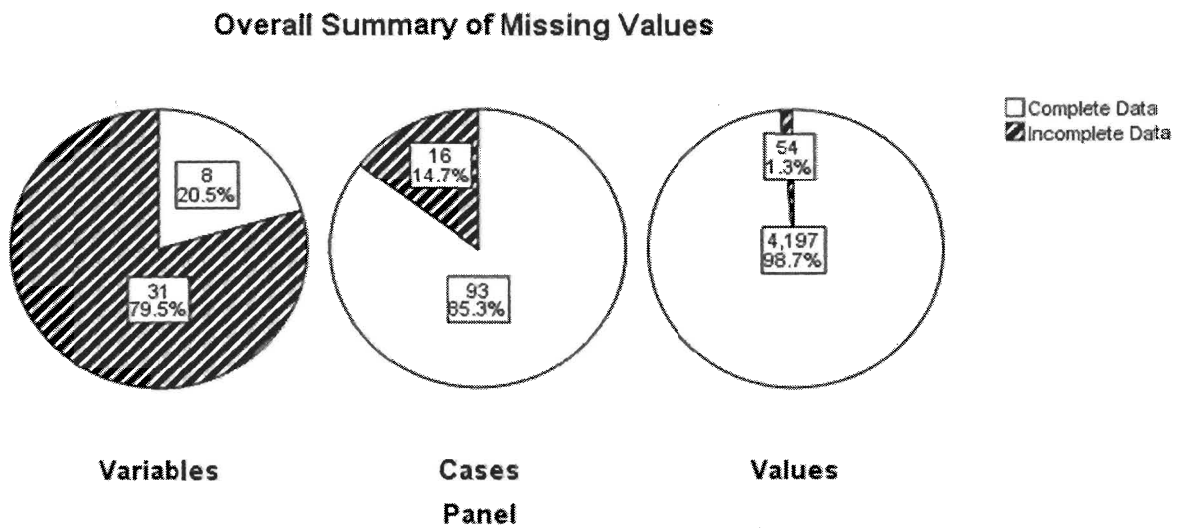
There were three teaching hospital and 26 community hospital laboratories participating in this study, representing 12 of the 14 LHINs. A total of 197 surveys had been mailed out with 109 returns, which represented a 56% response rate. The respondents consisted of 14 males, 89 females, and 6 with gender not indicated. The respondents indicated that they had been in their positions from 1 month to 41 years with an average of 14 years. In terms of hospital type, 29 returned surveys came from teaching institutes, 81 from community hospitals. The high return rate may come from

two reasons; first, the supervisors of the participants had a firm commitment to this survey. Second, respondents who were in the supervisory positions were aware of the organizational learning issue, and were keen to see the survey results of their profession. Because the survey was anonymous for both respondents and hospital names, only the region names appear on the list.

### *Missing Value Analysis*

The survey comprised five demographic questions, nine items on individual learning (IL1 to IL9), seven items on team learning (TL1 to TL7), and six items on open-mindedness (OM1 to OM6), commitment to learning (CL1 to CL6), and shared vision (SV1 to SV6). Among the demographic questions, 8 respondents missed the answer to the years in position and one person did not fill in the bed size. Only five of the nine questions related to individual learning had complete answers, while the other four questions had one answer missing. None of the questions related to team learning and organizational learning had complete answers.

Figure 11 shows the summary of missing values using pie charts to represent data. Only 8 of the 39 variables had no missing values, but variables with missing values happened in only 16 of 109 cases, and 1.3% of the total values. The majority of missing values could be traced to 3 respondents (number 4, 23, and 24). Respondent 4 missed all questions on team learning and open-mindedness, while respondent 23 missed three questions on individual learning, all questions on shared vision and commitment to learning. Respondent 24 missed only five questions but they were all in the same team learning section. This made it impossible to use regression and CCA to study the three cases on the relationship between individual and team learning, individual and



*Figure 11.* Pie charts of missing values based on variables, cases, and values.



organizational learning, and team and organizational learning. All three cases were removed from this study. Case 107 had two questions missing on commitment to learning section and one question in open-mindedness section. It was retained for the analysis as the number of missing values was not high (7.7%) and they came from two different sections of the questionnaire. The remaining 12 cases had only one to two questions missing, and did not have an effect on the analysis. They appeared to show MCAR pattern and the missing values (except case 109) were only 2.6%. When missing values were below 10%, any imputation methods are valid (Hair et al., 2006). In this study, mean substitution was the method of choice. Appendix G shows a missing value report from SPSS's output.

#### *Univariate Outliers of Survey Items*

Investigation on the relationship of individual, team, and organizational learning started with the assessment of outliers, where items in these sections of the questionnaire were converted to zscores (Appendix H). The zscores of the 34 items (IL1 to SV6) on 106 cases had values in the range of  $\pm 3$ , except ZscoreIL3 (making a tough decision is very satisfying) and ZscoreIL6 (I am always learning something new in my work). ZscoreIL6 violates extreme studentizes deviate as its absolute value -3.45 was slightly outside the lower bound of  $ESD_{100,.95} \pm 3.38$  (Rosner, 1995). However, Hair et al. (2006, p. 75) recommended a zscore of  $\pm 2.5$  as an outlier for 80 or fewer observations, and up to  $\pm 4$  for larger sample sizes. Investigation of the data showed that respondent number 14 was the only case that violated the assumption. Because the respondent only had one outlier out of 24 items, it was noted and retained for further analysis.

### *Univariate Normality of Survey Items*

The skewness and kurtosis of the 34 items (IL1 to SV6) indicated that they were in the range of  $\pm 1$  except IL6, which had skewness -1.05 and kurtosis 1.37. Skewness and kurtosis “values between  $\pm 1.0$  are considered excellent, but a value between  $\pm 2.0$  in many cases are also acceptable” (George & Mallery, 2007, p. 99). It was noted at this point that the standard errors of skewness and kurtosis are 0.235 and 0.465 (Appendix I). These values were important as the ratios (greater than  $\pm 2$ ) of many items would be considered deviant from normality (SPSS, 1999). However, the analysis proceeded without transformation on any of the variables because normality was not critical in the reliability test (Enders & Bandalos, 1999; Noris & Arojan, 2004).

### *Multivariate Outliers of Survey Items*

The criterion for evaluation of multivariate outlier was Mahalanobis distance (MD) which measured the position of each observation compared with the centre of all observations. The ratio of MD/degree of freedom followed the t distribution, and Hair et al. (2006) suggested using a ratio of 3 for a sample size of 100. Tabachnick and Fidell (1996), on the other hand, suggested that MD follow Chi square distribution ( $\chi^2$ ) and they should judge this parameter conservatively with  $p < .001$ . This study follows the criteria set out by Tabachnick and Fidell.

Table 4 presents cases with MD outside the critical ranges (values in brackets). Degree of freedom was the number of items in the questionnaire, which was used to search for a critical value of Chi square in the table (Tabachnick & Fidell, 1996, p. 846). For example, individual learning (MDIN) had 9 items in its section, so the degree of freedom was 9, and its critical value was 27.87. The table shows that cases 99 and 48 had

Table 4

*Critical Values for Multivariate Outliers*

	MDIN	MDTM	MDOM	MDCL	MDSV
Degree of freedom	9	7	6	6	6
X <sup>2</sup> crit (Tabachnick and Fidell)	27.87	24.32	22.45	22.45	22.45
Case (crit)	99(28.97)	72(28.4)	48(27.8)	5(23.1)	5(32.0)
					72(27.3)

one violation on MDIN (individual learning) and MDOM (open-mindedness). Cases 72 and 5 had two violations. Because there were no errors in data entry and these samples were from the target population, they remained in the analysis. As Tabachnick and Fidell (1996) suggested, if the researchers “decide that the outliers are sample from your target population, they remain in the analysis, but steps are taken to reduce their impact” (p. 69).

#### *Multivariate Normality of Survey Items*

Henze-Zirkler, and Mardia skewness with Mardia kurtosis, both are indicators of multivariate normality, indicated that none of the variables showed multivariate normality, except individual learning that appeared to have a joint normal kurtosis and skewness. Because normality was not critical in reliability tests, this study included all variables without transformation (Enders & Bandalos, 1999; Noris & Arojan, 2004).

#### Descriptive Statistics

Appendix I displays results of the 34 items from the survey which include means, standard deviations, skewness, and kurtosis. Among the answers to the survey, answers to IL 2 (“An important part of becoming a good employee is to continually improve work skill”) of the individual learning section had the highest score with a narrow range ( $M$  6.43, range 5-7). Respondents generally agreed that they continue to improve themselves, as the item had the lowest SD. Next to IL2 was IL4 (“It is important to me to learn from each of my job experiences”), which also showed lower values of standard deviation. IL1 (“There are not a lot of new things to learn in my job”) showed a wide swing with a low mean score and the highest SD. Among the 9 items in the section, IL7 (“Making mistakes is part of the learning process”) had the lowest mean score of 4.75.

Team learning scores appeared relatively stable, except TL2 (“My team handles difference of opinions privately or off-line, rather than publicly”). This item had a mean score below 4, suggesting a majority of supervisors thought that their teams did not have open discussions when different opinions existed. Open-mindedness and commitment to learning sections were close in mean and SD scores. Respondents did not agree with questions in the shared vision section, as 3 of its 6 items had scores less than 4. In addition, SV4 (“Employees view themselves as partners in charting the direction of the business unit”) received the lowest score in the survey.

#### Reliability Test

The open-mindedness (OM), commitment to learning (CL), shared vision (SV), individual learning (IL), and team learning (TL) were individually tested for their reliability with Cronbach’s coefficient. The IL variable showed a Cronbach’s alpha value of only .67, which was a questionable result. IL1 (“There are not a lot of new things to learn in my job”) showed poor correlations with other items in the same section, with no item to item correlation greater than .3, and item to total correlation was only .11. This item was removed and the repeated reliability test showed significant improvement in Cronbach’s alpha to .75.

The remaining four variables had alpha values greater than the acceptable level of 0.7. All variables could improve their reliability values if items in each variable were deleted. However, George and Mallery (2007) warned “Please be vividly aware that variables are not automatically dropped just because of a higher alpha results. There are often theoretical or practical reasons for keeping them” (p. 299). Because all of these variables were previously tested by other investigators, the remaining TL, OM, CL, and

SV were accepted without further revision. Table 5 shows the Cronbach's alpha values of IL, TL, OM, CL, and SV.

#### Assessment of Summated Scales

All items in IL, TL, OM, CL, and SV were totalled and averaged to create new scales- AIL, ATL, AOM, ACL, and ASV. These new variables were further investigated for outliers and normality at univariate and multivariate levels.

#### *Univariate Outliers and Normality of the Summated Scales*

The z-score values of the five variables showed no ESD violations, specifically case 14, which previously showed an outlier for IL6. This was the result of the summated procedure which reduced its impact.

The normality assumptions were important in the analysis of linear regression, SETCOR and MANOVA. Because of this critical assumption, Shapiro-Wilk as well as skewness/SE and kurtosis/SE are included in the assessment. Shapiro-Wilk was selected in this step because it was readily available in SPSS and SYSTAT. Shapiro-Wilk indicated that AIL, ATL, and ACL differ significantly from normality. However, skewness/SE (criterion  $\pm 2$ ) only identified ATL and ACL as deviations from normality.

#### *Transformation of Summated Scales*

Histograms of the violating variables (AIL, ATL, and ACL) showed that all three appeared to have negative skewness, but the plots yielded two patterns of skewness. AIL and ACL appeared with flatter peaks than ATL. After trying multiple types of transformation, ACL and AIL emerged as normal histograms with reflection and square root, while ATL needed reflection and logarithm. There was a small improvement in the transformation of AIL (SRAIL), from a significant value of .41 to .46. Table 6 shows

Table 5

*Cronbach's Alpha Values of IL, TL, OM, CL, and SV*

Variable	Cronbach's alpha
Individual Learning (IL)	.75
Team Learning (TL)	.76
Open-Mindedness (OM)	.81
Commitment to Learning (CL)	.86
Shared Vision (SV)	.84

Table 6

*Shapiro-Wilk Normality Test with Skewness and Kurtosis*

Variable	Shapiro-Wilk		Skewness			Kurtosis		
	Statistic	Sig.	value	SE	Ratio	Value	SE	Ratio
SRAIL	.98	.05	-.13	.24	-.55	-.84	.47	1.81
LATL	.99	.61	.03	.24	.14	.10	.47	.22
SRACL	.98	.15	-.03	.24	-.13	-.24	.47	-.52
AOM	.99	.44	-.31	.24	-1.29	.08	.47	.17
ASV	.99	.31	.13	.24	.55	.20	.47	.43



the normality test of the five variables based on Shapiro-Wilk and skewness/SE ratio. All variables, except SRAIL showed values above significant level of .05.

#### *Multivariate Outliers and Normality of the Summated Scale*

The data of the five variables were free from univariate outliers and appeared to show normality with Shapiro-Wilk and skewness/SE criteria. However, these data also needed to be examined for multivariate normality and outliers. There were two processes for this examination.

SETCOR required multivariate normality assumption of independent variables. In this study, SRAIL and LATL had been assessed together as a set of independent variables. The related procedure, canonical correlation, was not critical as it can accommodate nonnormal distribution (Hair et al., 1998, p. 448).

MANOVA requires measuring the values of SRACL, ASV, and AOM simultaneously. It needs multivariate normality and outlier assessment by groups.

#### *Normality and Outliers for SETCOR*

The two independent variables were analyzed together for multivariate normality with Henze-Zirkler test. The result showed no violations of Henze-Zirkler and Mardia statistics for multivariate normality. Mahalanobis distance indicated all values were below the outlier threshold ( $X^2_2 = 13.81$ ).

#### *Normality and Outliers for MANOVA*

Normality and outliers for MANOVA were complex as they required assessment of individual groups at univariate and multivariate levels. The analysis of normality and outliers of the two laboratory groups are addressed on page 112 with regard to research question 4.

### *Descriptive Statistics and Correlations of Summated Scales*

The means and standard deviations and correlations of summated scales from the five variables are presented in Table 7. All correlations were significant at  $p < .001$ .

Results showed moderate direct correlations among variables. The negative signs needed to be interpreted in an opposite direction because SRAIL, LATL, and SRACL had been reversed since these scales showed negative skews.

### *Research Question Results*

The following sections provide results, interpretation, and rationale to answer the research questions.

#### *Question 1*

Linear regression was the investigation method used for the relationship of individual learning and team learning. Prior to the statistical analysis, a scatter plot was produced to check the pattern of relationship by SPSS. Because the graph showed linear trend, the simple linear regression was the method of choice.

Figure 12 shows the scatterplot of SRAIL against LATL, representing individual learning and team learning. The plot also displays the reference, dotted line to indicate a perfect correlation. As noted in the graph, the  $R^2$  of the correlation was 0.309. The result suggested that 30.9% of the variance in LATL (team learning) was explained by SRAIL (individual learning). With regard to the first question, the result indicated that individual learning correlated with team learning.

Table 8 is the model summary and coefficient values of the equation. The table notifies readers of the dependent (LATL) and independent (SRAIL) variables used in the

Table 7

*Descriptive Statistics and Correlations of Summated Scales*

Variable	Mean	Std. deviation	SRAIL	LATL	AOM	ASV
SRAIL	1.53	.23				
LATL	0.53	.11	.56			
AOM	4.74	1.08	-.42	-.58		
ASV	4.05	1.13	-.39	-.45	.68	
SRACL	1.73	0.34	.50	.58	-.74	-.66

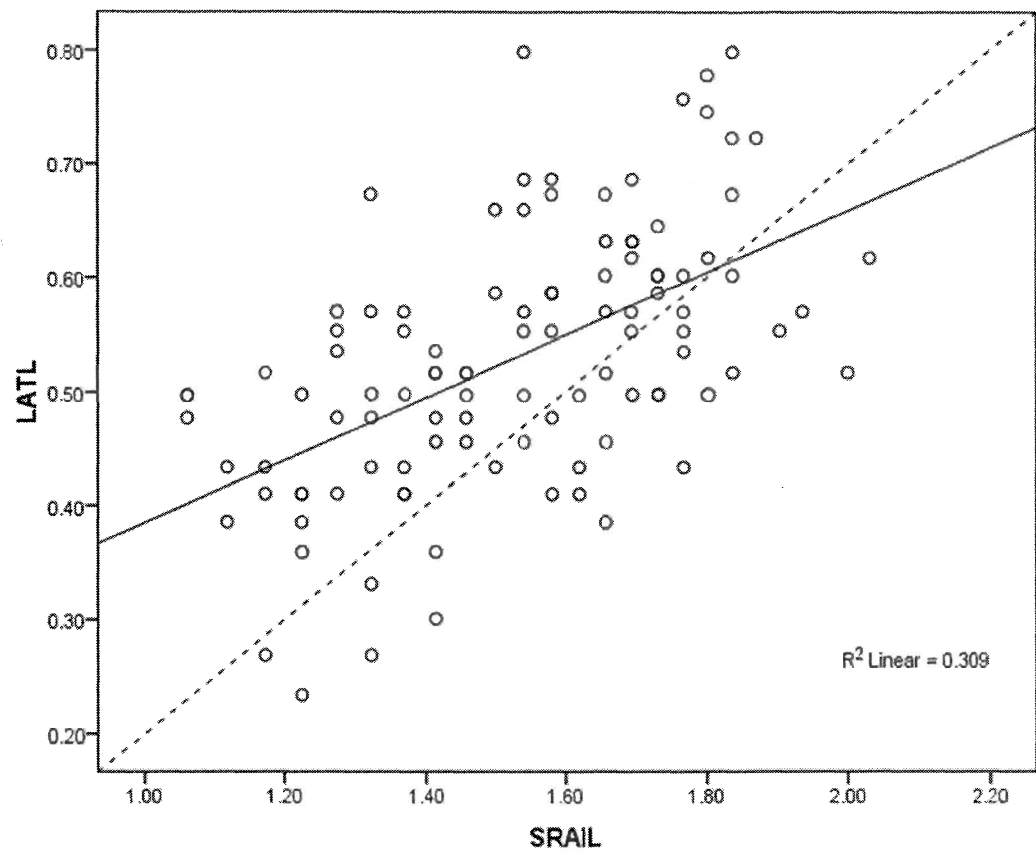


Figure 12. Scatterplots of SRAIL vs. LATL.

Table 8

*Results of Linear Regression of Individual and Team Learning (N =106)*

Variable	B	SE B	$\beta$
Constant	.110	.062	
Individual learning (SRAIL)	.27*	.040	.56

*Note.*  $R^2 = .31$ , \*  $p < .01$ . Dependent variable: LATL

analysis. As well, reported in the note are the  $R^2$  and the probability level. The table shows the coefficient values (B) of the slope and the intersect. It also reports the corresponding standard errors of both coefficient values. Because the t value of SRAIL was significant, the model was accepted.

The estimated model of the relationship between individual learning and team learning is:

$$\text{LATL} = .11 + .27 \text{ SRAIL}$$

The above equation means that LATL is equal to 0.27 times SRAIL scores plus 0.11. Although the equation is straightforward, readers have to understand that LATL and SRAIL are the transformation scores of team learning and individual learning. As mentioned in the previous section (Transformation of summated scales, page 95), LATL is the log of the reversed score of ATL ( $\log [8 - \text{ATL}]$ ) and SRAIL is the square root of the reversed score of individual learning ( $\sqrt{8 - \text{AIL}}$ ).

#### *Validation of Linear Regression*

The validation of the regression model was achievable with the 1,000 bootstrap technique with a sample size of 106. The bootstrap techniques yielded results similar to those from the parametric technique. Both coefficients for the constant (.11) and SRAIL (.27) from the bootstrap were extremely close to those from the parametric technique (.110, and .27). This indicated that the normality assumption held quite well and the coefficients were reliable results. Because bootstrap was a nonparametric method, it reported the ranges and median. The lower and upper bounds of SRAIL coefficient were .2 to .35, which were statistically significant ( $p < .05$ ) through the entire range.

### *Questions 2 and 3*

Canonical correlation analysis (CCA) was one of the tools used for the study of questions 2 and 3-whether individual learning and team learning correlated with organizational learning. SPSS produced more than a page of results, but I selected only the relevant values for the interpretation.

Table 9 reports two canonical correlations (.65 and .15), but the second value had no statistical significance ( $p = .33$ ). This suggested that the combination of individual learning and team learning were moderately correlated with organizational learning.

Canonical correlation was optimistic and not a variance shared by the dependent and independent variables, but derived from the linear combination of the two sets. Therefore, a high canonical correlation did not necessarily mean that there was a strong correlation between the two sets.

Table 10 presents four types of coefficient values that researchers use in combination with canonical correlation for the interpretation of canonical correlation analysis (CCA). These are canonical coefficient, canonical weight, canonical loading, and cross loading.

CCA generated canonical coefficient values of -1.47 and -6.75 for SRAIL and LATL. The coefficient values of the dependent set are .42, -1.75 and .04 for AOM, SRACL, and ASV. The raw coefficient values did not indicate the comparative contributions of each variable to the equation because their measurement units were not identical (i.e., SRAIL was a square root transformation and LATL was in a log format). It was more informative with standardized canonical coefficient.

Table 9

*Canonical Correlation Values between Set1 (SRAIL and LATL) and Set 2 (AOM, ASV, and SRACL)*

Canonical Function	Canonical Correlation	Canonical R <sup>2</sup>	Wilks' lambda	Probability
1	.65	.42	.57	.00
2	.15	.02	.98	.33



Table 10

*Coefficient Values of Raw Canonical Coefficient, Canonical Weight, Canonical Loading, and Canonical Cross-Loading*

Variable	Canonical Coefficient	Canonical Weight	Canonical Loading	Canonical Cross-Loading
Set 1				
Individual learning(SRAIL)	-1.47	-.34	-.77	-.50
Team learning (LATL)	-6.76	-.77	-.96	-.62
Set 2				
Open-mindedness (AOM)	.42	.45	.91	.59
Commitment to learning (SRACL)	-1.75	-.59	-.95	-.61
Share-vision (ASV)	.04	.04	.73	.47

The standardized canonical coefficients of the first set showed the values of -.34 for zSRAIL and -.77 for zLATL, suggesting team learning contributed more toward the canonical variate (Table 10). The standardized values of set 2 indicated that zASV (.042) did not have much weight in comparison to zAOM (0.45) and zSRACL (-.59).

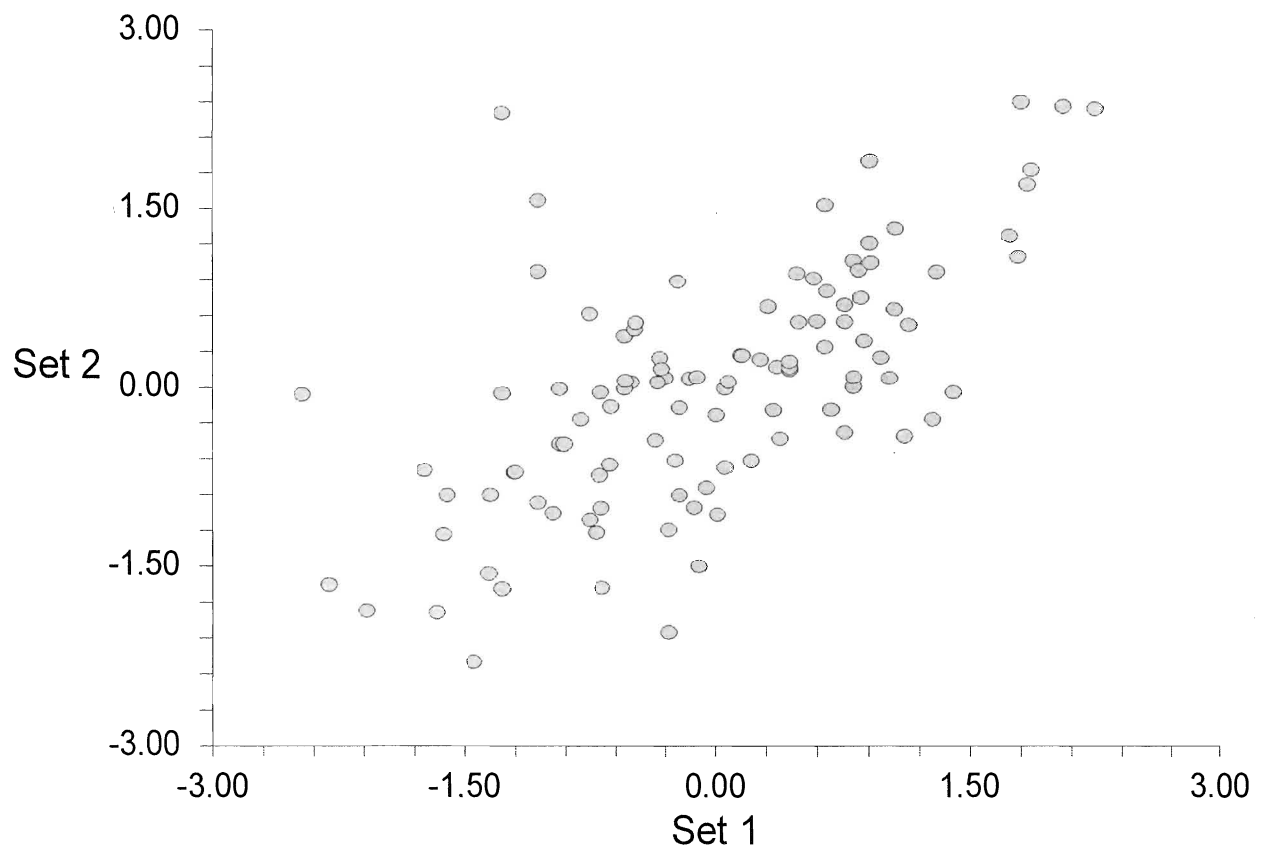
The linear combination in equation format was:

$$.45 \text{ zAOM} - .59 \text{ zSRACL} + .04 \text{ zASV} = - .34 \text{ zSRAIL} - .77 \text{ zLATL}$$

The standardized canonical scores could be plotted in two dimensions as shown in Figure 13.

Just like canonical correlation, canonical weight also had its own issue. Canonical weights were unstable. When different data sets were used in the analysis, the weights might change. Because of this problem, canonical loading became an alternative for the interpretation. Canonical loading yielded a similar conclusion as canonical weight in this study. The first set had canonical loadings of -.77 for SRAIL and -.96 for LATL, suggesting LATL had a stronger correlation to its variate. The second set showed the loading for AOM, SRACL, and ASV to be .91, -.95 and .73, respectively. The negative signs in the canonical coefficient and canonical loading were the results of reversion in the transformation, and they needed to be interpreted in the opposite direction.

Canonical cross loading showed the correlation of variables in one set with the opposite variate. The values of SRAIL (-.50) and LATL (-.62) indicated that LATL contributed more to the correlation with the opposite canonical variate. The square values of SRAIL  $(-.50^2)$  suggested that the variable has 25% shared variance with the opposite variate, which was the organizational learning construct in this study. Variables



*Figure 13.* The relationship of individual and team learning (Set1) with organizational learning (Set 2).

in the cross loading of set 2 indicated that only AOM and SRACL had practical significance in the correlation with the opposite variate, because their square values were 35% and 38%, respectively. The minimum practical significance value was 25%.

Results from canonical correlation analysis gave enough reasons to conclude that individual learning and team learning individually and as a set correlated with organizational learning. However, the result did not indicate which components of organizational learning (i.e., open-mindedness, commitment to learning, and shared vision) correlated with individual learning or team learning. To explore their issue, I utilized SETCOR as an analytical tool.

A series of semipartial and bipartial correlation analyses were carried out as illustrated in Table 11. In this table, any variables following the period were partialled out from the set. For example, ASV.AOM, SRACL meant the AOM and SRACL were partialled out from ASV. Table 11 also reports the  $R^2$  values as well as their significances with an asterisk.

There were two independent variables in this study: SRAIL and LATL. Rows 4 and 5 of Table 11 column 2 showed significant correlations of SRAIL and LATL to the dependent set (SRACL, ASV, and AOM) with an  $R^2$  value of .26 and .19 which were significant at  $p < .01$ . The  $R^2$  of .43 (row 6, column 2) supported the result of canonical correlation that the two sets shared common variance. This value was quite close to square canonical correlation of .419 ( $.65^2$ ) as reported in Table 9.

The third, fourth, and fifth columns displayed bipartial and semipartial correlations of the dependent and independent variables. Column 3 looked at the relationship of SRACL to SRAIL, LATL, individually, and as a set. As shown in the

Table 11

*R<sup>2</sup> Values of Set, Semipartial and Bipartial Correlations between Independent and Dependent Variables*

Independent Variable (X)	Dependent variable (Y)			
	Organizational Learning	Unique Components		
	SRACL, ASV, AOM	SRACL.ASV, AOM	ASV.AOM, SRACL	AOM.ASV, SRACL
SRAIL	.26**	.00	.00	.06*
LATL.SRAIL	.19*	.051*	.00	.01
SRAIL,LATL	.43**	.054*	.00	.07*

Note. \*p < .05, \*\*p < .01

table, SRAIL had no significant correlation ( $R^2$  .003,  $p$  .56) with SRACL, but LATL had a significant value  $R^2$  .051 ( $p$  .02). Column 4 presented the relationship of ASV and the two independent variables. Neither LATL nor SRAIL correlated with ASV. The last column investigated the relationship of AOM and the independent variables. In this column, SRAIL had significant correlation with AOM ( $R^2$  = .06,  $p$  .00), but LATL had no significant correlation with AOM ( $p$  .40).

The above table informs the readers about the perception of laboratory supervisors on the three components of the organizational learning. Column 4 indicates that neither individual learning (SRAIL) nor team learning (LATL) had any significant relationship with shared vision (ASV), not even when the two were combined into a set. In column 3, team learning, but not individual learning, correlated with commitment to learning (SRACL). The last column is the opposite of column 3, individual learning, not team learning correlates with open-mindedness (AOM). In summary, these results answer questions 2 and 3 as follows:

Does individual learning correlate with organizational learning for laboratories in Ontario hospitals?

There is a weak positive correlation between individual learning and OL, but only one OL component (open-mindedness) contribute to this relationship.

Does team learning correlate with organizational learning for laboratories in Ontario Hospital?

Team learning is weakly correlated with organizational learning, and the component that contributes to this relationship is commitment to learning.

### *Validation of Canonical Correlation*

The validation of canonical correlation results employs bootstrap with 1,000 replications using the sample size of 106. The program executed the script commands and saved the canonical correlation values in the SYSTAT output file (Appendix B). These results were plotted as histograms and are superimposed with normal curves as shown in Figures 14 and 15. Canonical correlation 1 (C1, Figure 14) had a negative skew, while canonical correlation 2 (C2, Figure 15) showed a positive one. However, all 1,000 values of canonical correlation 1, which fell in the range of .41 to .83 were significant ( $p < .05$ ). Although its median and mean were not identical, they were quite close (.66 and .67) to the canonical correlation value (.65) from the conventional method. Canonical correlation 2 had a value varying from .01 to .48 with mean and median .19 and .18. The conventional method reported canonical correlation .15, which was about 25% below the bootstrap mean of .19.

### *Question 4*

MANOVA is based on the assumptions that dependent variables of each group are normally distributed with no outliers at univariate and multivariate levels. These rules are difficult to observe when the sample size is small.

The normality and outliers for the three dependent variables of each hospital type were reassessed with SPSS boxplot and MD for the univariate and multivariate outliers. SPSS outputs identified two cases (47 and 98) that had more than one outlier. They were removed from the analysis, and the boxplot showed five cases with one outlier (Figure 16). Despite these outliers, MD did not show any multivariate outliers in each type of laboratories. Thus, the analysis proceeded with the remaining 104 cases.

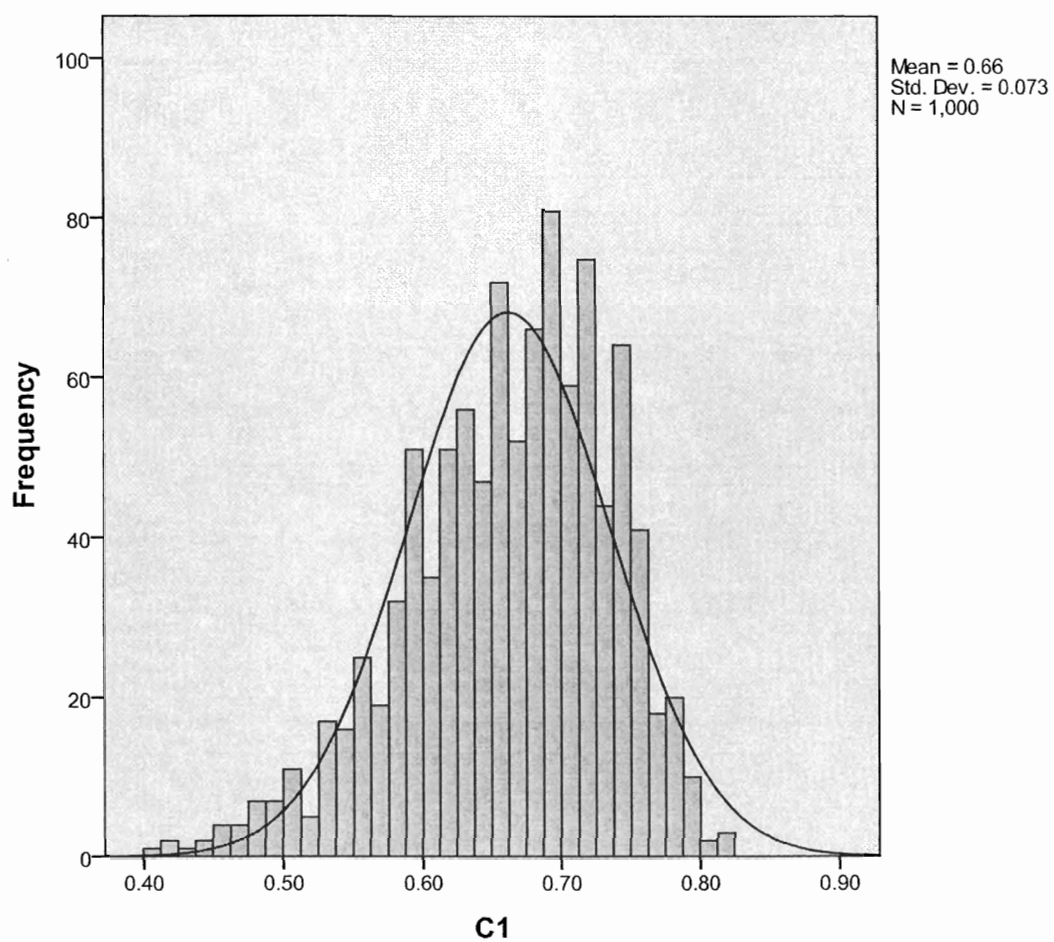
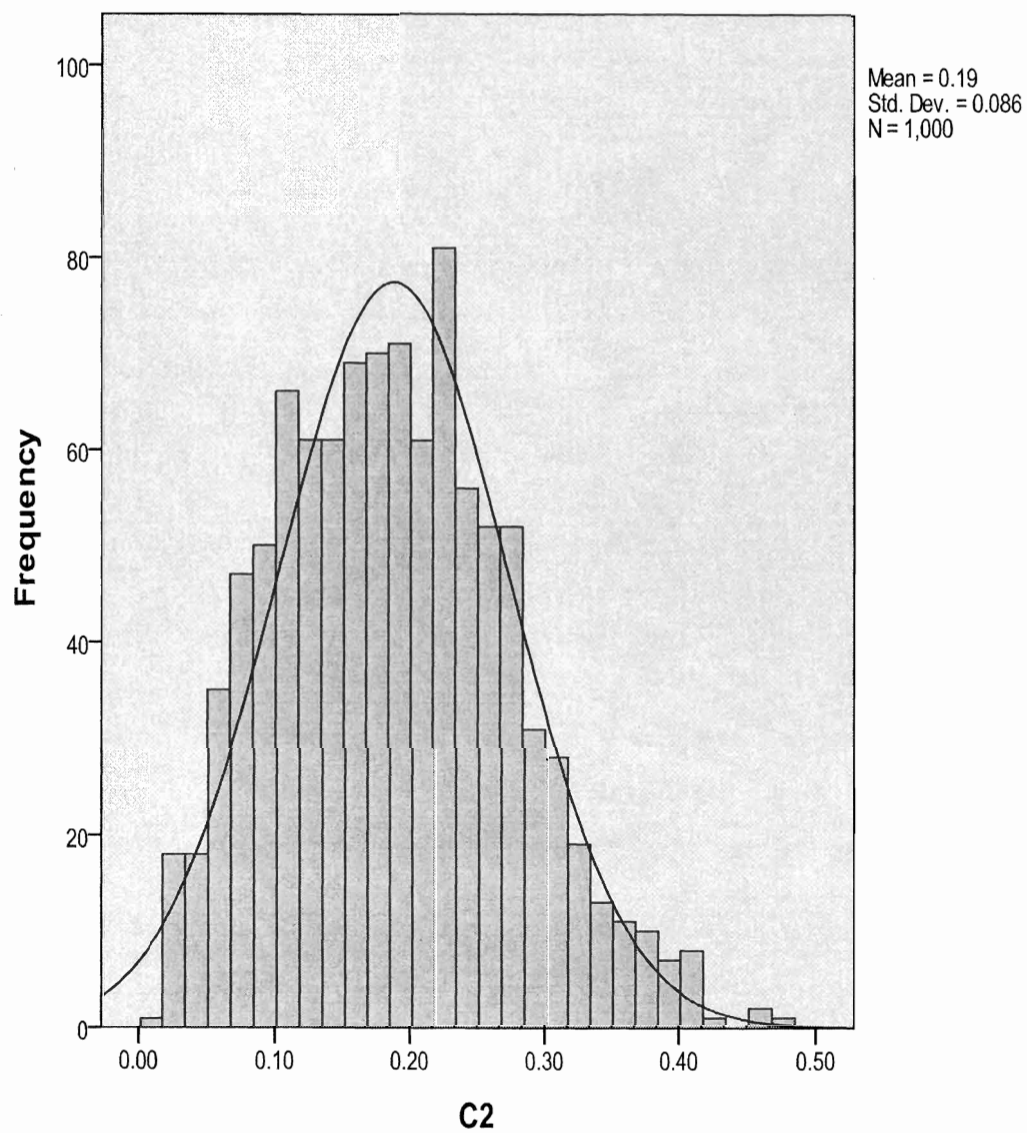


Figure 14. Histograms of 1,000 bootstrap replications of the first canonical correlations.





*Figure 15.* Histograms of 1,000 bootstrap replications of the second canonical correlations.

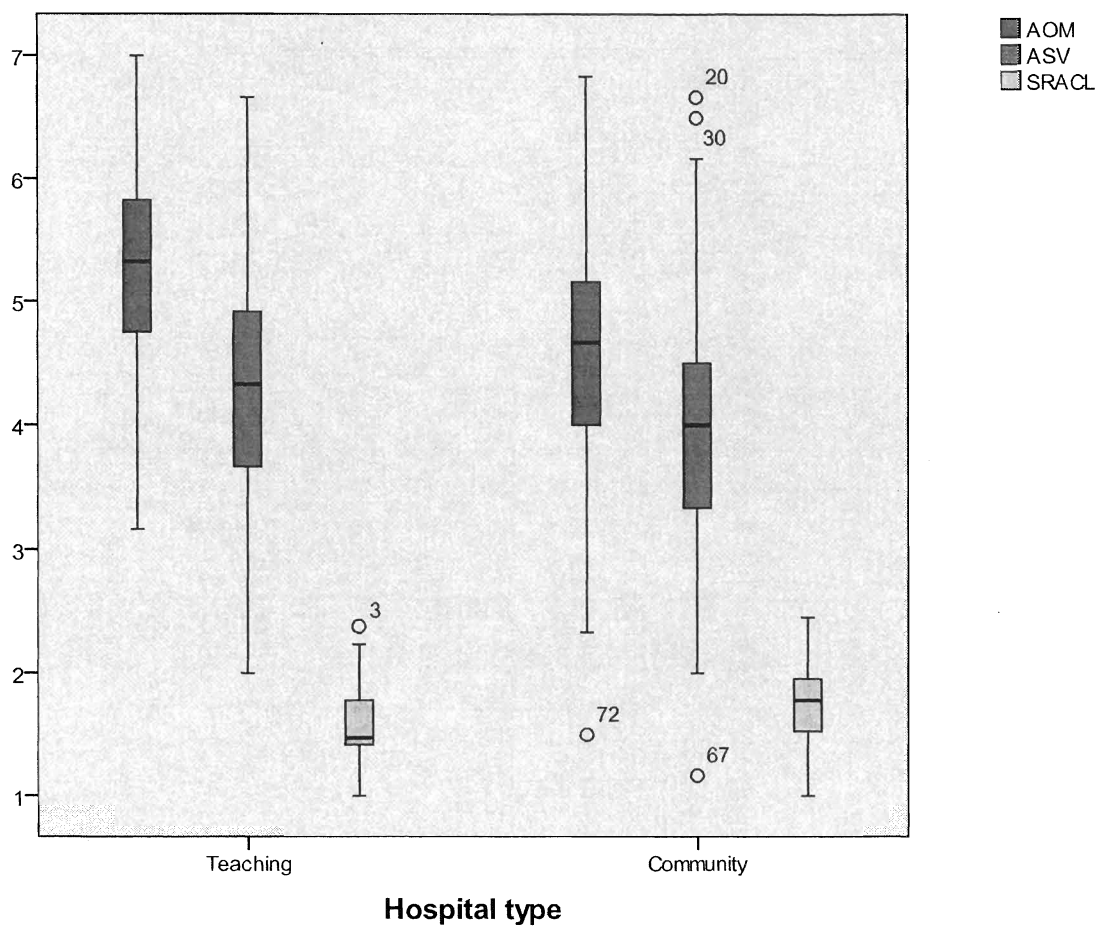


Figure 16. Boxplot of ASV, AOM, and SRACL for laboratories in teaching and community hospitals.

Both univariate and multivariate normality required another assessment based on group. Shapiro-Wilk showed that SRACL, AOM, and ASV of the community and teaching hospital groups had  $p > 0.05$ , suggesting that they did not deviate from normal distribution. Henze-Zirkler values also indicated that community and teaching hospital groups had test statistic  $p$  values of .39 and .97.

Data for the MANOVA analysis met all three assumption criteria: (a) Box's test of equality of covariance matrix, (b) Levene's test of equality, and (c) Barlett's test of sphericity. There was no violation of homoscedasticity assumption as Box's test showed a probability value of 0.87. Leven's test, which assessed the spread of variance of individual variables, showed that the three variables did not violate the assumption ( $p > .05$ ). Barlett's test of sphericity indicated a significant number of correlations among dependent variables ( $p < .01$ ). The MANOVA analysis showed that there are significant differences between the two laboratory types (Wilks'  $\lambda = .88$ ,  $F = 4.36$ ,  $p < .05$ ). The subsequent analysis of the individual dependent variables suggested that SRACL ( $p < .05$ ) and AOM ( $p < .05$ ) but not ASV ( $p = .29$ ) were statistically significantly different between the two laboratory types.

The difference in learning scores was not only shown at the organizational level, but also at the individual learning and team learning levels. T-tests of individual learning and team learning of the two groups indicated that both SRAIL ( $p < .05$ ) and LATL ( $p < .05$ ) of the two hospital types were significantly different.

Comparison of t-test on individual learning between the two types of hospitals indicated that laboratory supervisors in teaching hospitals scored higher than those of community hospitals ( $M = 5.95$  vs.  $5.56$ ,  $p < .05$ ). Comparison of team learning scores

between the two groups of laboratory supervisors also indicated that supervisors in teaching hospitals had a higher score than those employed in the community hospitals ( $M = 4.93$  vs.  $4.49$ ,  $p < .05$ ).

#### *Validation of Test Result*

Again, this study used bootstrap as a validation technique. Bootstrap at sample sizes of 27 and 77 had been repeated 1,000 times for MANOVA. The script command (Appendix C) generated and captured Pillai, Hotelling, and Wilks parameters for distribution assessment. Figure 17 shows the histogram of 1,000 Wilks' lambda, and is superimposed with a normal distribution curve. The Wilks' lambda had 95% confident range (2.5 – 97.5 percentile) of .73 to .96 with a median value of .86 (broken line), comparing to the conventional method of .88 (solid line). The higher the Wilks' lambda was, the greater the probability value. Wilks' value of .93 had a probability of .05, and any value above this level was deemed statistically insignificant. Therefore, there was a possibility of obtaining a contradictory conclusion when performing MANOVA of two groups with these sample sizes.

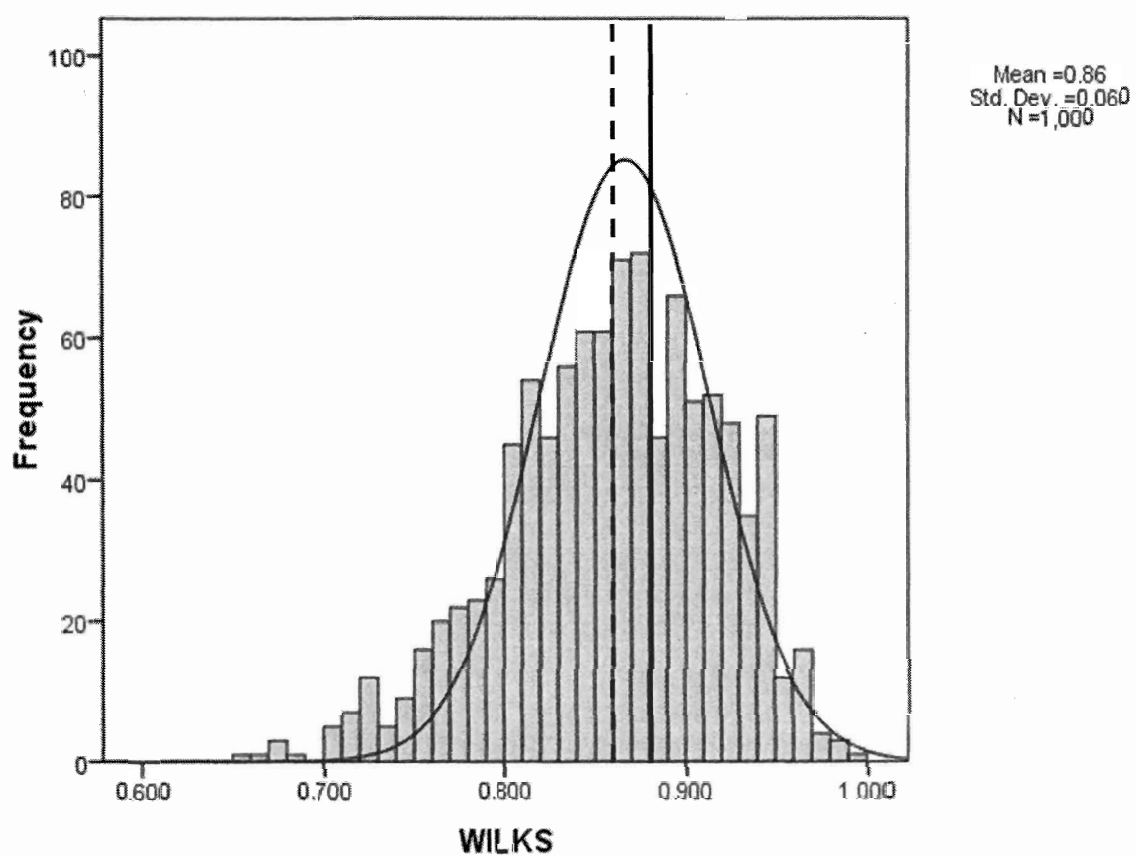


Figure 17. Histograms of Wilks' lambda from 1,000 bootstraps.

## CHAPTER FIVE: DISCUSSION, CONCLUSIONS, AND FUTURE RESEARCH

This chapter begins with the discussion of the result of each individual item in all sections of the survey questionnaire. It then compares the correlation results of this survey with those of Chan (2003) and Chan, Lim et al. (2003) who used a similar survey instrument. The chapter recommends that researchers investigate the relationship between individuals and teams in organizations with other models such as the one proposed by Altman and Iles (1998).

### Individual Learning

Coad and Berry (1998) reported performance oriented employees try to outperform others and are more concerned with achieving positive evaluations. They try to avoid challenging tasks that can lead to failure and being viewed as incompetent. In contrast, learning oriented employees make themselves more competent by taking challenging tasks and viewing failures as a part of the learning process. The authors also found that learning orientation is associated with transformational leadership and performance orientation is associated with transactional leadership. A study in the U.S. military school at West Point suggests that officers who are learning oriented together with propensities to trust others are more positive toward change (Campbell & Campbell, 2009). The average score of the individual learning section of the laboratory supervisors is 5.61. Hospital CEOs and vice presidents may find results from this study encouraging, since the average score is above the middle point of 4. However, a study of European managers finds that younger generations (born in 1960 and after) with stronger learning orientation have lower organizational commitment than older generations. The younger generations do not believe that they can depend on organizations for job security. This

may lead to a shift in the psychological contract between employers and employees (D'Amato & Herzfeldt, 2008).

Among the answers of the survey in the individual learning section, answers to item 2 (continually improve work skill) has the highest score ( $M = 6.43$ ). Respondents generally agreed that they continued to improve themselves as it has the highest mean and the lowest standard deviation. This suggests that laboratory supervisors think that they can increase their knowledge and skill. Porter and Tansky (1996) suggested that people who believe that intelligence is expandable would set their goal toward learning orientation. They view failure as an opportunity because it fosters their learning capability, and will attempt to improve performing the same task without being discouraged by their failure. Learning orientation trait is associated with commitment to organization, adopting new technology and intention to be long term employees (D'Amato & Herzfeldt, 2008). Barret, Balloun, and Weinstein (2005) also found that this characteristic is desirable and associated with organizational performance in business, services, education, and healthcare sectors. On the other hand, Porter and Tansky found that people who believe that intelligence is a fixed entity are focused on performance orientation in their goal setting. This type of person wants to gain positive judgement, and as long as their confidence is high, they will seek challenges. When individuals encounter failure they would be discouraged, give up, and avoid future challenges.

The lowest score (4.75) of individual learning is IL7 ("Making mistakes is just part of the learning process"), which has a SD of  $\pm 1.65$ . The wide swing of this score indicates that respondents disagree on this statement. It may come from the fact that mistakes in the laboratories can have a serious effect in patients' well-being. Patients can

get hurt and lose their lives because of laboratory errors. In addition, our society is working on individual blame logic. It always tries to identify a person who is responsible for the mishaps so it can impose penalty. This logic assumes that people make mistakes and nothing is wrong with the system. By removing the bad individuals, the system can restore itself to the original function. This kind of thinking puts people who make mistakes in a defensive mode, and they may try to cover their errors. It discourages learning in organizations. An alternative to the individual blame is the organizational function logic which searches for conditions and mechanisms that reduce errors. This method does not give a sense of justice to the injured party but it encourages learning in the organization (Catino, 2008).

There is one expert who encourages employers not to pay workers based on job done, but on skills learned (Musselwhite, 1988). This is because rewards that are based on pay for performance will lead to a learning strategy that deviates from mastering learning. However, hospitals do not appear to follow this recommendation. In many organizations, laboratory technologists have to go through a cross-training process so they can develop multi skills and become capable of working in more than one discipline. They do not receive additional compensation for increasing capability such as multitasking. Although, this gives more benefits to hospitals, it also benefits employees, as they make themselves more employable.

### Team Learning

The team learning section shows a wide swing of opinions among respondents as it has a broader range of standard deviations. Edmondson (1999) indicated that good teams normally discussed their different opinions openly and not in private. Item 2 of



this section (“My team handles differences of opinions privately off-line, rather than publicly”) has the lowest mean score (3.79), suggesting respondents disagreed with the statement. It may indicate that the practice of handling conflicts in clinical laboratories are still resolved behind closed doors, and trust may be an issue among this group of supervisors. Trust is one of the key factors that promote team learning. A recent study shows that trust and social interaction are positively correlated with degree of knowledge sharing and collective learning (Wu, Hsu, & Yeh, 2007).

Clutterbuck (2002) categorized team development into six types. Stable teams perform the same task with a relatively stable membership and rarely question how the work is done. Hit teams dissolve in a short period of time, and exist only to solve specific issues. Evolutionary teams are in a mature stage, and members have become acquainted with each other. New members find it difficult to join as they lack the experience required by the team. Cabin crew teams constantly have changing memberships similar to airline crew teams. Development alliances are teams that are concerned with what people learn. Virtual teams depend on the intuitiveness of the members to ensure that learning takes place. In the laboratory field, staff turnover rate is not high, and members perform the same task repeatedly. This means that their work team falls into the stable team category. This type of team does not put a great effort into learning until external crisis forces team members to change their attitudes. Respondents do not give high ranks on items TL5 and TL6 ( $M = 4.17$  and  $4.83$ ) on the reflection and testing the work assumptions, suggesting people prefer to follow the orders of authorities. Laboratory personnel can make progress in team learning through open discussion among themselves. Nissila (2005) suggested that collective dialogue in the reflection process

creates an exploration of the complex and subtle issue which leads to team learning.

Reflection as a team prevents individual members from jumping to conclusions and helps members understand the real problem. It encourages participants to think critically and work collaboratively. It is one of the critical steps of action learning (Kesby, 2008).

### Open-mindedness

In order to help us deal with the complex details of the world around us, we carry images, stories, and assumptions in our minds. The deeply ingrained mental model shapes our behaviours and tells us how to react to situations. If we believe that people are untrustworthy, we would act differently than with people we think are honest and dependable (Senge, 1992). Open-mindedness is the ability to question our own assumptions about the organization's operational routines and willing to accept new ideas. This would lead to a higher level of understanding of the processes, which Argyris and Schon (1978) called double loop learning. Studies in organizational learning show that open-mindedness leads to increasing a firms' innovation and, in turn, improved their performances (Calantone, et al., 2002), knowledge sharing (Liao, 2006), and customer relations.

Open-mindedness can be improved through coaching and mentoring (Kaplowitz, 1992), and can be enhanced through problem-based learning (Ozturk, Muslu, & Dicle, 2008). People with open-mindedness rely on intrapersonal intelligence to make distinctions among other individuals (Clark & Fujimoto, 1990). In a profession that has a reward system that puts emphasis on detail, error free, and tightly protocol dependent, such as in a diagnostic laboratory, it is not easy for employees to experiment and try something outside the realm of knowledge. The open-mindedness section appears

moderate with mean item scores ranging from 4.52 to 4.98, and there are wide swings of opinion as shown in standard deviations. This may be the result of the workplace environment where unions and management are not aligned in the change direction. When organizations are facing financial difficulty, hospitals and manufacturing firms alike use layoff and downsizing as common methods to reduce expenses and increase effectiveness. Hospital laboratories in Ontario have continued to be a target of budget reduction over the past 15 years. Laboratory personnel have seen their work condition deteriorate through increasing frequency of shift work, cross training, and rising workload. This creates conflict between labour and management, hinders learning in organization, and staff are not open to change. Farrell and Mavondo (2004) argued that organizational downsizing is a form of single loop learning which has a negative effect on learning orientation.

### Commitment to Learning

There are no lacks of commitment to learning in organizations, as employers spend billions of dollars to support their workers' education. American Society of Training and Development reports that organizations spend more than \$134 billion in internal and external educational functions (Editor's note, 2008). Although the current economic downturn has curtailed the learning budget, 31% of corporations say the slumping economy did not affect their educational investment. In fact, many organizations are looking for learning function as a solution to the difficult economic condition (Paradise, 2009). Research in organization learning find that commitment to learning is correlated with the compensation system and improvement in customer

relation, but does not show a significant relationship with knowledge sharing behaviour (Chang, 2007; Jerez-Gomez, Crespedes-Lorente, & Valle-Cabrera, 2007; Liao, 2006).

Among the items related to commitment to learning, laboratory supervisors give the highest score ( $M = 5.09$ ) on CL1 “learning as a key of improving.” However, when people say that they are committed to learning, it does not mean that they actively seek education to update their skills. Their commitment to learning happens only when the training is available on the job, and there is a clear linkage between learning and working practice (Goodwin & O'Connor, 2007). Yeo (2006) learned that a reward and recognition system, a clear understanding, and a clear direction are the key enablers that lead to organizational learning. These three common avenues require commitment from individuals, teams, and organizations. Respondents show moderate agreement on other items, ranking them 4.81 to 4.83.

#### Shared Vision

Three of the six items in shared vision appear to have scores below the middle 4, suggesting respondents do not have a high opinion in this component of organizational learning. S4 (employees view themselves as partners) receives the lowest score (3.54) among 34 items in the survey. This may be the result of deficiency in communication among laboratory staff. As one laboratory supervisor points out in her comment that “top leadership team deliver information on a need to know” basis. Carroll and Edmondson (2002) learned that creating a sense of shared purpose in workplaces required broad participation, open communication, and resources. Shared visions in organizations require more than just making people work side by side. All primary healthcare professionals need to have a common goal, understand each other’s role, show respect to

colleagues across professions, share patients' information, and recognize that team work requires work (Sargeant, Loney, & Murphy, 2008). Walker and Floyd (2003) showed the Bosserman model to create and communicate a shared vision in an organization. The model incorporates purpose, principles, and intentions which are consistent with the action and culture of the organization. Organizations must enable individuals to experiment within the formal system by connecting them to stakeholders who examine a new policy, program, or relationship, and communicate in an organization-wide way. One of the communication methods that result in deep learning and building a shared vision is dialogue (Deakins, 2007). The technique puts questions to participants on what they would like to see their organization become in the future for their own sake. What kind of customers, range of activities, reputation, and contribution to the community do they want? These questions led to a series of discussions and debates among employees, managers, and board members that resulted in a better understanding, consensus, and trusting relationship.

Shared vision should uplift people's aspiration. However, shared vision requires real effort from management. Simply posting the mission and vision statements on the wall is not enough. Cannon and Edmondson (2001) stated in their report "that organizational efforts to develop a learning-oriented culture through vision statements and management actions are not sufficient in and of themselves" (p. 175). Members of the same team must share their beliefs on prediction and decisions, and what action to take when confronting failure. These authors found that barriers to learn from the failure in organizations could be overcome in three ways: (a) coaching by managers or team leaders, (b) clear direction, and (c) supportive work context. The managers and team

leaders who have a face-to-face contact with workers can deliberately reframe the failure as something to learn from, and not to be ashamed of. A clear direction indicates to workers what constitutes failure, so they will not get into a defensive mode because they are afraid of the punishment. The group support environment must make it easier for employees to discuss mistakes and failure. In spite of these findings, it is difficult to learn from errors without assigning blame on individuals who made mistakes, especially when a mistake leads to a loss of life. More than 400 cases of transfusion mistakes were reported in New York State between 1990 and 1999. Five of these led to a fatal reaction (Linden, Wagner, Voytovich, & Sheehan, 2000). In New Brunswick, a group of more than 100 patients is taking legal action against their hospital for misdiagnosing breast and prostate cancers (Judge orders stay of request, 2009). With liability that can lead to job loss and high financial penalty, it is difficult to make people feel unthreatened and admit their errors.

#### Relationship of Individual Learning and Team Learning

Ames and Archer (1988) categorized achievement goals of students in the classroom into two types: mastery goal and performance goal. The former goal focuses on improving oneself, working hard to meet the challenge, and trying to learn something new. The latter defines achievement as high grades, and doing better than others. It elicits anxiety as it keeps students in high alert. The authors developed a survey instrument to study how students use these two strategies in the classroom. Sujan et al. (1994) later modified the instrument to study the performance of salespeople, and Chan, Lim et al., (2003) changed a few words in their instrument to examine the linkages between team

learning behaviour and team performances. This is the same instrument that I used in this study.

There are three variables (i.e., organizational context, team leaders, and team context) that influence the abilities of teams to work effectively. Organizational structures encompass a reward system, support, motivation task, group composition, and clear direction. These features require coaching and directing that are guided by team leaders. If team leaders display authoritative and punitive characters, members would be reluctant to give open and honest opinions. An effective team is dependent on team effort, the amount and skill of members, and the appropriateness of the task at hand. The three variables are antecedent conditions that shape the mental model of psychological safety in their work team. Edmondson (1996) used these three variables to develop the team learning behaviour instrument that comprises seven items in her thesis. It is the same instrument that this study used for team learning.

The regression model was selected as a method of investigation because the metric nature of the independent and dependent variables. As shown in Figure 13, the scatter plot of the independent and dependent variables is leaning toward a linear rather than another type of relationship. The linear regression suggests a moderate correlation ( $R^2 = .309$ ,  $p < .01$ ) between individual learning and team learning. Both variables appear to have negative skews and need reflection prior to transformation into square root and logarithmic formats.

A previous study on individual and team learning in one for-profit hospital in Australia shows an unstandardized coefficient of the independent variable .38 ( $p < .001$ ) (Chan, 2003). However, the correlation between individual learning and team learning is

much weaker with  $R^2$  .06 with an adjusted  $R^2$  of .05. These values are much weaker than the results in my study which show an  $R^2$  and adjusted  $R^2$  of .31 and .30, respectively.

His weak correlation result might come from the following facts:

1. Chan's sample is composed of several professions in the hospital, varying from security personnel to physicians and executives. These professions with various educational levels perceive the organization in different manners. Some professions believe that they are not valued equally in the organization. Kvarnstrom (2008) learned that interprofessional healthcare teams have difficulty in collaboration among themselves because of the hierarchical valuation of the various professions in hospitals. The sample in my study is homogenous as it comprised only one profession within a relatively same hierarchical level in hospitals. Their educational backgrounds are similar, with either college diplomas or bachelor degrees, and all are members of the same professional college, which regulates their practice and education.
2. All employees of this study work in not-for-profit organizations and under the same Ontario provincial guidelines. Chan's study used employees who worked in a private for-profit Australian hospital. Cultural aspects of individual learning and team learning may explain the differences, as private organizations' goal is profit driven. Individual learning in not-for-profit organizations does not have to be overly concerned about performance goal as much as people in for-profit organizations. They can put more emphasis on improving themselves and learn something new rather than trying to do better than their colleagues.



3. Chan's study had a larger sample size than this study (189 vs. 106). However, the small sample size does not prevent its effectiveness. The sample size from this study has yielded a full statistical power. In addition, the bootstrap results show almost identical values for coefficients of constant (0.110 vs. 0.107) and independent variable (.274 vs. .277).
4. This study deleted one item from the analysis because of its item to total correlation value was below the acceptable level. Its Cronbach's alpha was .74 after deletion of the first item- "not a lot of new things to learn." Chan's study deleted three items "not a lot of new things to learn", "making tough decision is very satisfying," and "making mistakes is just part of the learning process" from individual learning because of poor factor loading. Chan, Lim et al. (2003) used the same instrument without modification and found Cronbach's alpha of this construct was .80. Sujan et al. (1994) used confirmatory factor analysis with LISREL<sup>TM</sup> and found that this construct was unidimensional, and convergent with reliability of .81.
5. Chan's team learning construct had 10 items in which 5 are identical to those in this study.
6. This study pays detailed attention to statistical outliers and normality at both univariate and multivariate levels. Dependent and independent variables have been transformed into square root and logarithmic formats prior to the linear regression analysis. The bootstrap result shows values almost identical to the conventional technique.

### Individual Learning, Team Learning, and Organizational Learning

Canonical correlation analysis cannot answer the question as to whether individual learning or team learning singly correlates with any specific component of OL. It tells us that both individual and team learning correlate with OL. SETCOR analysis gives us more insight into the relationship of these constructs. SETCOR analysis results indicate that individual learning correlates with open-mindedness, but not with shared vision or commitment to learning. Team learning, on the other hand, correlates with commitment to learning but not with open-mindedness or shared vision. This is a startling contradiction from scholars who suggest shared vision is the core components of organizational learning (Clark & Fujimoto, 1990; Huffman, 2003; Senge, 1990). Huffman stated that organization vision has two purposes. One is to focus on personal skill such as development of trust, communication, and collaboration. Another is to identify specific areas for improving content knowledge. It is surprising to learn that shared vision does not correlate with individual learning or team learning. The items in this section on total agreement have a mean value of 3.71, while the one on employees viewing themselves as partners receives an even lower rating of 3.54. These two items have the lowest scores among the 34 items in the survey. The low score of this section indicates that the majority of respondents do not accept shared vision as an area for improving services.

The results of this study support Kim's (1993) model (Figure 3) that individual learning is the agent for both team learning and organizational learning, as it correlates with both dependent variables. In their study, Chan, Lim et al. (2003) did not find any significant correlation between individual learning and any of the three components in

organizational learning. However, these authors categorized team learning into internal and external team learning. They indicated that internal team learning had only a weak correlation with shared vision, but external team learning had correlations with all three components. Their result supported Yeo's (2002b) model (Figure 2) because individual learning correlates with team learning and team learning correlates with organizational learning. There are differences between the study of Chan, Lim et al. (2003) and this study.

1. Differences in population. Chan and colleagues used a sample from a population in Brunei who lived in a collectivist society where group values are prevalent. Western society is based on individual rights and freedoms, where labour law allows employees to form unions to protect their rights and interests.
2. The subjects in this study are homogenous laboratory managers in Ontario, while their subjects came from mixed industries varying from government to petroleum company employees.
3. This study uses canonical correlation analysis and SETCOR to test organizational learning assumptions. Chan and colleagues used a general linear model.
4. Although items in the organizational learning are the same, individual learning and team learning items are not identical.

In spite of these differences, one would expect to reach the same conclusion if the organizational learning theory is valid. That is, individuals are the agents of organizational learning as established by this study.

### Laboratory Type and Organizational Learning

Laboratories in community hospitals scored significantly lower in OL than in teaching hospitals. These results disagree with those from Cuthill (2001), who studies food manufacturing firms and learns that small firms scored higher in OL than in large firms. The differences in survey instruments and industries might contribute to this contradiction.

Not only are OL scores significantly lower in community hospitals than teaching hospitals, the scores on individual learning and team learning of the former are also significantly lower. These differences may reflect differences in opportunities and accessibility to learning between the two types of laboratories. Laboratories in teaching hospitals have many medical specialists and scientists, who also hold teaching posts in university and conduct research in the laboratories. Laboratory staff members in teaching hospitals have opportunities to travel abroad to participate in scientific conventions. They make their presentation at meetings, and publish their findings in academic journals. Their large hospital sizes and in-house expertise give teaching hospitals an opportunity to get into a niche market such as performing esoteric, genetic and molecular laboratory testing. Laboratory staff members in these teaching hospitals are constantly exposed to new knowledge and skill.

Coetzer and Perry (2008) reported that there are four key factors that influence employee learning in small organizations. They are: (a) external environment, (b) work environment, (c) learning potential of the job, and (d) learning orientation of employees. All these factors are applicable to employees in small laboratories. The external influence such as government regulation, advances in technology, competition, and customer

requirements can act as learning stimuli. Small hospitals provide a limited number of laboratory tests for the community. Most of the sophisticated laboratory tests are referred to teaching hospitals and research laboratories. On occasions, government agencies may come up with new regulations which compel laboratory employees to upgrade their skills. The professional college would also obligate technologists to obtain continuous education credits. Work environment is dependent on employee practices and resource paucity. In the workplaces that regularly assess employees through performance appraisal, managers can take opportunities to challenge their staff to develop new skills. However, small laboratories have limited budgets and cannot always provide resources that their employees need. Small laboratories only require employees to become familiar with certain procedures that do not change very often. This limits their learning potential on the job. The last factor that impedes employees in small laboratories to learning is the lack of potential for advancement in the workplace. Employees who motivate themselves to learn are doing it for the sake of learning.

During economic downturns, the learning budget is a target of reduction. Laboratories in community hospitals do not have much room to increase their budget unless they could show that they have an increase in volume which comes from growing population, or a change in government policy that leads to an overall improvement in health care such as developing new chemotherapy centres in smaller cities. Beyond these two opportunities, learning in small laboratories normally focuses on improving productivity rather learning new skills. Garcia-Morales et al. (2007) reported that personal mastery as described by Senge (1990) have a direct influence on organizational learning. They found that small and medium sized companies which have employees

ranging from 50 to 250 pay less attention to the development of personnel. These companies have difficulty defining what their organizations' learning needs are.

However, Senge (1990, p. 172) suggested that personal mastery is a matter of choice and no one should be forced into it. Organizations should not be too aggressive promoting personal mastery for their employees, but rather providing a safe place where people create visions, commit to the truth, and challenge status quo. Creating a compulsory internal personal growth training program will impede the true commitment to personal mastery in an organization.

Schimmel and Muntslag (2009) identifies six barriers to single loop and double loop learning in organizations: (a) environment, (b) strategy, (c) culture, (d) structure, (e) management processes, and (f) information systems. Three of these barriers can be applied to the laboratory setting in community hospitals. The structure refers to the division of labour, and specialized departments that lead to a lack of countervailing power that can challenge the ideas of specialists. There are four main divisions of labour in laboratories: (a) medical specialists, (b) scientists, (c) managers, and (d) technologists. Technologists, scientists, and managers do not challenge medical specialists on laboratory issues due to the hierarchical structure. This lack of discourse leads to deficiency in double loop learning in laboratories, but it is more pronounced in smaller hospitals. The rigid socialized cultural system in which different groups of professions do not communicate is the cause of neglecting feedback. Unlike people in teaching hospitals, people in small community hospitals know each other due to the proximity of their offices in the workplace. This gives small laboratories an advantage in communication. Management and processes that depend on the reward system to promote

compliance do not encourage employees to take risk and experiment with new ideas. This process does not allow employees to challenge the assumptions that promote double loop learning. In small laboratories the wide gap of educational background between medical specialists and laboratory technologists leads to asymmetric information, which makes it difficult for low level staff to challenge assumptions.

### Future Research

There are many qualitative investigations in organizational learning, but quantitative studies on the subject are few. Quantitative research in organizational learning prefers to focus on organizational performance rather than on the relationship between individual learning and organizational learning. This may come from the fact that corporate earning is the goal of for-profit organizations.

Although many scholars agree that individual learning is the key ingredient for organizational learning, individuals also learn from organizations. New members in organizations normally go through orientation processes to learn protocol, procedure, and “the way we do things around here.” Individuals learn from teams as well as passing information to them. This suggests a mutual learning among organizations, teams, and individuals. This idea appears similar to Altman and Iles’s (1998) proposal (Figure 4), which requires further investigation.

### Conclusion

This study answers the four research questions that were set out at the beginning of this thesis using a quantitative approach with a sample from laboratory supervisors in Ontario. The study results show that

1. There is a moderate positive correlation between individual learning and team learning.
2. There is a positive correlation between individual learning and organizational learning, and it appears that open-mindedness, which is a component of OL contributes to this relationship.
3. There is a positive correlation between team learning and organizational learning. The main thrust of this association is from commitment to learning.
4. There are differences in learning scores between laboratories in teaching and community hospitals. Laboratory supervisors in teaching hospitals scored significantly higher in individual learning, team learning, and OL.

Since individual learning has a positive correlation with OL, and OL positively correlates with organizational performance (Baker & Sinkula, 1999; Goh & Ryan, 2008; Jiang & Li, 2008; Lopez, Peon, & Ordas, 2005), employees at all levels in large and small corporations can contribute to the improvement of their organizations. Employers can reap the benefit of organizational learning, including better responses to external pressure and improved customer relations (Argyris, 1999), by opening their mind and providing psychological safety to employees. Without fear of being penalized, employees can question incorrect assumptions of their routine practice, which can lead to change and improvement in organizations.

The thesis has tried to ascertain that its statistical analyses follow the parametric assumptions, and validated results with the bootstrap technique which produced more than 4,000 pages of text document for MANOVA and canonical correlation analysis. Although bootstrap is not perfect, it is still better than not using any validation at all.



The results cannot be generalized beyond hospital clinical laboratories in Ontario, as respondents were only selected from one group of professionals in the province. Studies that use different groups of professionals in different geographic locations may generate different findings. Chan, Lim et al. (2003) suggested that culture may play a part in organizational learning. They suggested that people in certain cultures are brought up to be obedient and respect authority. These groups of people do not question assumptions, and are more likely to leave them unchallenged. In an individualistic society, such as North America, people have the right to bargain through their labour unions. In many instances, it creates conflicts, but conflicts create doubt and can make both sides explore their assumptions. We learn by questioning what we do, why we made mistakes, and how we can correct them. We engage in dialogue and challenge each other's ideas to improve our understanding and learning. Learning in organizations is the key to improve organizational performance and benefit society at large.

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## Appendix A

### Survey Instrument

Please complete all items in all sections of the survey as soon as possible and return it in the self addressed envelope provided

#### Hospital information

Hospital types: ☐ teaching hospital ☐ community hospital

Your title: ☐ director ☐ manager ☐ chief ☐ charge ☐ MLT

☐ supervisor ☐ tech specialist ☐ senior ☐ teaching tech

Gender ☐ male ☐ female

Number of years in this position (.....)

Number of beds: ☐ > 300 ☐ 100 - 300

Individual learning: Please circle only one response per item.

	Strongly Disagree							Strongly Agree
1. There are not a lot of new things to learn in my job.	1	2	3	4	5	6	7	
2. An important part of becoming a good employee is to continually improve work skill.	1	2	3	4	5	6	7	
3. Making a tough decision is very satisfying.	1	2	3	4	5	6	7	
4. It is important to me to learn from each of my job experiences.	1	2	3	4	5	6	7	
5. I spend a great deal of my time learning new work approaches.	1	2	3	4	5	6	7	
6. I am always learning something new in my work.	1	2	3	4	5	6	7	
7. Making mistakes is just part of the learning process.	1	2	3	4	5	6	7	
8. Learning how to be a better employee is of fundamental importance to me.	1	2	3	4	5	6	7	
9. Sometimes I put a great deal of effort into learning something new.	1	2	3	4	5	6	7	

Team Learning: Please circle only one response per item.

		Strongly Disagree					Strongly Agree		
1.	We regularly take time to figure out ways to improve our work processes.	1	2	3	4	5	6	7	
2.	My team handles differences of opinions privately or off-line, rather than publicly	1	2	3	4	5	6	7	
3.	Team members go out and get all relevant work information they possibly can from others – such as customers, or other parts of the organization.	1	2	3	4	5	6	7	
4.	This team frequently seeks new information that leads us to make important changes.	1	2	3	4	5	6	7	
5.	In my team, someone always makes sure that we stop to reflect on our work process	1	2	3	4	5	6	7	
6.	People in my team often speak up to test assumptions about issues under discussion.	1	2	3	4	5	6	7	
7.	We invite people from outside the team to present information or have discussion with us.	1	2	3	4	5	6	7	

Open-mindedness: Please circle only one response per item.

Strongly		Strongly						
		Disagree				Agree		
1.	We are not afraid to reflect critically on the shared assumption we have about the way we do business.	1	2	3	4	5	6	7
2.	Our managers in this business unit do not want their “view of the world” to be questioned.	1	2	3	4	5	6	7
3.	Our business unit places a high value on open-mindedness.	1	2	3	4	5	6	7
4.	Managers encourage employees to “think outside the box”.	1	2	3	4	5	6	7
5.	An emphasis on constant innovation is not part of our corporate culture.	1	2	3	4	5	6	7
6.	Original ideas are highly valued in this organization.	1	2	3	4	5	6	7

Commitment to learning: Please circle only one response per item.

Strongly		Strongly						
		Disagree					Agree	
1.	Managers basically agree that our business units' ability to learn is the key to our competitive advantage.	1	2	3	4	5	6	7
2.	The basic values of this business unit include learning as a key to improvement.	1	2	3	4	5	6	7
3.	The sense around here is that employee learning is an investment, not an expense.	1	2	3	4	5	6	7
4.	Learning in my organization is seen as a key commodity necessary to guarantee organizational survival.	1	2	3	4	5	6	7
5.	Our culture is one that does not make employee learning a top priority.	1	2	3	4	5	6	7
6.	The collective wisdom in this enterprise is that once we quit learning, we endanger our future.	1	2	3	4	5	6	7

Shared Vision: Please circle only one response per item.

Strongly		Strongly						
		Disagree					Agree	
1.	There is a well expressed concept of who we are and where we are going.	1	2	3	4	5	6	7
2.	There is total agreement on our business unit vision across all levels, functions, and divisions.	1	2	3	4	5	6	7
3.	All employees are committed to the goals of this business unit	1	2	3	4	5	6	7
4.	Employees view themselves as partners in charting the direction of the business unit.	1	2	3	4	5	6	7
5.	Top leadership believes in sharing its vision for the business unit with the lower levels.	1	2	3	4	5	6	7
6.	We do not have a well-defined vision for the entire business unit.	1	2	3	4	5	6	7

Comment \_\_\_\_\_

\_\_\_\_\_

## Appendix B.

### BOOTSTRAP SCRIPT COMMANDS FOR CANONICAL CORRELATION

#### CANONICAL CORRELATION ANALYSIS

GENERATING CANONICAL CORRELATION OUTPUT FILE, USING BOOTSTRAP WITH 1000 REPLICATIONS

```
SETCOR
>USE "D:\THESIS\UPDATED 106"
>MODEL ASV AOM SRACO = SRAIL LATL
>PUSH CLASSIC
>OUTPUT "D:\THESIS\CANCOR10"
>CLASSIC ON
>ESTIMATE /SAMPLE =BOOT(1000)
>OUTPUT
```

#### CAPTURING CANONICAL CORRELATION PARAMETERS

```
>GET "D:\THESIS\CANCOR10"
>INPUT A$,B$,C$,D$
>LET C1=.
>LET C2=.
>LET FOUND=.
>IF A$="Canonical" AND B$ ="Correlations" THEN LET FOUND = CASE
>IF LAG(FOUND)=. THEN DELETE
>LET C1= VAL(B$)
>LET C2=VAL(C$)
>DSAVE "D:\THESIS\PARAM CANCOR"
```

## Appendix C

### BOOTSTRAP SCRIPTS COMMAND FOR MULTIVARIATE ANALYSIS OF VARIANCE

#### MANOVA

GENERATING MANOVA OUTPUT FILE, USING BOOTSTRAP WITH 1000 REPLICATIONS

```
>USE "D:\THESIS\UPDATED 106"  
>MODEL ASV AOM SRACO = CONSTANT +HOSP_TYPE  
>PUSH CLASSIC  
>OUTPUT "D:\THESIS\GLM1000"  
>CLASSIC ON  
>ESTIMATE/SS=TYPE3 SAMPLE=BOOT(1000)  
>OUTPUT
```

#### Capturing WILKS's LAMBDA

```
>GET "D:\THESIS\GLM 1000"  
>INPUT A$,B$,C$,D$,E$,F$  
>LET WILKS=.  
>LET FOUND =.  
>IF A$= "HOSP_TYPE" THEN LET FOUND=CASE  
>IF LAG (FOUND,58)==. THEN DELETE  
>LET WILKS=VAL(E$)  
>DSAVE "D:\THESIS\WILKS PARAM"
```

#### NOTE

The script commands for capturing Pillai and Hotelling traces are identical to Wilks's lambda except their positions are different. Pillai's and Hotelling's positions are 59 and 60 respective

## Appendix D

**Group A Hospitals – General / Teaching**

- 
- |             |   |
|-------------|---|
| 1) HAMILTON | <b>HAMILTON HEALTH SCIENCES CORPORATION</b><br>- Chedoke Hospital Site<br>- Hamilton General Hospital Site<br>- Henderson General Hospital Site<br>- McMaster University Medical Centre Site  |
| 2) HAMILTON | <b>ST. JOSEPH'S HEALTHCARE, HAMILTON</b><br>- St. Joseph's Hospital Site  |
| 3) KINGSTON | <b>KINGSTON GENERAL HOSPITAL</b>  |
| 4) KINGSTON | <b>RELIGIOUS HOSPITALLERS OF SAINT JOSEPH OF THE HÔTEL DIEU OF KINGSTON</b><br><b>HÔTEL DIEU HOSPITAL</b>   |
| 5) LONDON   | <b>LONDON HEALTH SCIENCES CENTRE</b><br>- South Street Site<br>- University Site<br>- Victoria – Westminster Site   |
| 6) LONDON   | <b>ST. JOSEPH'S HEALTH CARE, LONDON</b><br>- Parkwood Site<br>St. Joseph's Health Centre Site<br>Regional Mental Health Care , London<br>Regional Mental Health Care , St. Thomas   |
| 7) OTTAWA   | <b>CHILDREN'S HOSPITAL OF EASTERN ONTARIO</b>   |
| 8) OTTAWA   | <b>THE OTTAWA HOSPITAL / L'HÔPITAL D'OTTAWA</b><br>- Civic Campus<br>- General Campus<br>- The University of Ottawa Heart Institute Site<br>(Note : Operates under its own legislation but is not legally recognized as a public hospital.) |
| 9) TORONTO  | <b>MOUNT SINAI HOSPITAL</b>   |
| 10) TORONTO | <b>ST. MICHAEL'S HOSPITAL</b><br>- St. Michael's Site   |
| 11) TORONTO | <b>SUNNYBROOK HEALTH SCIENCES CENTRE</b><br>- Orthopedic and Arthritic Hospital Site<br>- Sunnybrook Hospital Site  |

**12) TORONTO      THE HOSPITAL FOR SICK CHILDREN**

**13) TORONTO      UNIVERSITY HEALTH NETWORK**

- Toronto General Hospital Site
- Toronto Western Hospital Site
- Ontario Cancer Institute/Princess Margaret Hospital Site

**14) TORONTO      WOMEN'S COLLEGE HOSPITAL**

## Appendix E

**Group B Hospitals – General > 100 Beds**

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- Ontario Street Site

- |               |   |
|---------------|---|
| 1) AJAX       | <b>ROUGE VALLEY HEALTH SYSTEM</b><br>- Ajax and Pickering Health Centre Site          |
| 2) BARRIE     | <b>THE ROYAL VICTORIA HOSPITAL OF BARRIE</b>  |
| 3) BELLEVILLE | <b>QUINTE HEALTHCARE CORPORATION</b><br>- Belleville Site                             |
| 4) BRAMPTON   | <b>WILLIAM OSLER HEALTH CENTRE</b><br>- Brampton Site                                 |
| 5) BRANTFORD  | <b>THE BRANTFORD GENERAL HOSPITAL</b>   |
| 6) BROCKVILLE | <b>BROCKVILLE GENERAL HOSPITAL</b>  |
| 7) BURLINGTON | <b>JOSEPH BRANT MEMORIAL HOSPITAL CORPORATION</b>                                     |
| 8) CAMBRIDGE  | <b>CAMBRIDGE MEMORIAL HOSPITAL</b>  |
| 9) CHATHAM    | <b>ST. JOSEPH'S HEALTH SERVICES ASSOCIATION OF CHATHAM, INCORPORATED</b>              |
| 10) CHATHAM   | <b>THE PUBLIC GENERAL HOSPITAL SOCIETY OF CHATHAM</b>                                 |
| 11) COBOURG   | <b>THE NORTHUMBERLAND HEALTH CARE CORPORATION</b><br>- Cobourg Site                   |
| 12) CORNWALL  | <b>CORNWALL COMMUNITY HOSPITAL</b><br>- McConnell Avenue Site<br>- Second Street Site |
| 14) GUELPH    | <b>THE GUELPH GENERAL HOSPITAL</b>  |
| 15) KENORA    | <b>LAKE OF THE WOODS DISTRICT HOSPITAL</b>  |
| 16) KITCHENER | <b>GRAND RIVER HOSPITAL CORPORATION</b><br>- Kitchener-Waterloo Health Centre Site    |
| 17) KITCHENER | <b>ST. MARY'S GENERAL HOSPITAL</b>  |



- |                    |  |
|--------------------|--|
| 18) LINDSAY        | THE ROSS MEMORIAL HOSPITAL   |
| 19) MARKHAM        | MARKHAM STOUFFVILLE HOSPITAL   |
| 20) MISSISSAUGA    | THE CREDIT VALLEY HOSPITAL   |
| 21) MISSISSAUGA    | TRILLIUM HEALTH CENTRE<br>- Mississauga Site   |
| 22) NEWMARKET      | SOUTHLAKE REGIONAL HEALTH CENTRE   |
| 23) NIAGARA FALLS  | NIAGARA HEALTH SYSTEM<br>- Greater Niagara General Site  |
| 24) NORTH BAY      | NORTH BAY GENERAL HOSPITAL<br>- Scollard Site<br>- Maclaren Site                               |
| 25) OAKVILLE       | HALTON HEALTHCARE SERVICES CORPORATION<br>- Oakville Site                                      |
| 26) ORANGEVILLE    | HEADWATERS HEALTH CARE CENTRE<br>- Orangeville Site  |
| 27) ORILLIA        | ORILLIA SOLDIERS' MEMORIAL HOSPITAL  |
| 28) OSHAWA         | LAKERIDGE HEALTH CORPORATION<br>- Oshawa Site  |
| 29) OTTAWA         | HÔPITAL MONTFORT   |
| 30) OTTAWA         | QUEENSWAY-CARLETON HOSPITAL  |
| 31) OWEN SOUND     | GREY BRUCE HEALTH SERVICES<br>- Owen Sound Site  |
| 32) PEMBROKE       | PEMBROKE REGIONAL HOSPITAL INC.  |
| 33) PETERBOROUGH   | PETERBOROUGH REGIONAL HEALTH CENTRE<br>- PRHC Hospital Drive Site<br>- PRHC Rogers Street Site |
| 34) RICHMOND HILL  | YORK CENTRAL HOSPITAL  |
| 35) ST. CATHARINES | NIAGARA HEALTH SYSTEM<br>- St. Catharines General Site   |

- |                      |   |
|----------------------|---|
| 36) ST. THOMAS       | THE ST. THOMAS - ELGIN GENERAL HOSPITAL   |
| 37) SARNIA           | <b>LAMBTON HOSPITALS GROUP</b><br>- Sarnia General Site<br>- Charlotte Eleanor Englehart Site                                     |
| 38) SAULT STE. MARIE | <b>SAULT AREA HOSPITAL</b><br>- Sault Area Hospital Site<br>- The Plummer Memorial Public Hospital Site                           |
| 39) SIMCOE           | <b>NORFOLK GENERAL HOSPITAL</b>   |
| 40) STRATFORD        | <b>STRATFORD GENERAL HOSPITAL</b>   |
| 41) SUDBURY          | <b>HÔPITAL RÉGIONAL DE SUDBURY REGIONAL HOSPITAL</b><br>- Laurentian Site<br>- Memorial Site<br>- St. Joseph's Health Centre Site |
| 42) THUNDER BAY      | <b>THUNDER BAY REGIONAL HEALTH SCIENCES CENTRE</b>  |
| 43) TIMMINS          | <b>TIMMINS AND DISTRICT HOSPITAL L'HÔPITAL DE TIMMINS ET DU DISTRICT</b>  |
| 44) TORONTO          | <b>HUMBER RIVER REGIONAL HOSPITAL</b><br>- Church Street Site<br>- Finch Avenue Site<br>- Keele Street Site                       |
| 45) TORONTO          | <b>ROUGE VALLEY HEALTH SYSTEM</b><br>- Centenary Health Centre Site   |
| 46) TORONTO          | <b>THE SCARBOROUGH HOSPITAL</b><br>- General Division Site<br>- Grace Division Site   |
| 47) TORONTO          | <b>WILLIAM OSLER HEALTH CENTRE</b><br>- Etobicoke Site  |
| 48) TORONTO          | <b>THE TORONTO EAST GENERAL HOSPITAL</b>  |
| 49) TORONTO          | <b>ST. JOSEPH'S HEALTH CENTRE</b>   |
| 50) TORONTO          | <b>NORTH YORK GENERAL HOSPITAL</b><br>- General Division Site<br>- Branson Division Site  |
| 51) WELLAND          | <b>NIAGARA HEALTH SYSTEM</b>  |

- Welland Hospital Site

**52) WINDSOR**

**HÔTEL-DIEU GRACE HOSPITAL**

- Hôtel Dieu Site
- Grace Site

**53) WINDSOR**

**WINDSOR REGIONAL HOSPITAL**

- Metropolitan Site
- Western Site

**54) WOODSTOCK**

**WOODSTOCK GENERAL HOSPITAL**

## Appendix F

## Research Ethics Board Clearance Letter



**Brock  
University**

Office of Research Services

Research Ethics Office

St. Catharines, Ontario, Canada L2S 3A1

T: 905-688-5550, Ext. 3035/4876 F: 905-688-0748

[www.brocku.ca](http://www.brocku.ca)

DATE: December 18, 2008

FROM: Michelle McGinn, Chair  
Research Ethics Board (REB)

TO: Xiaobin Li, Education  
Sumeth Tanyaovalaksna

FILE: 08-162 LI/TANYAOVALAKSNA  
Masters Thesis/Project

TITLE: The Relationship of individual, team and organizational learning in Ontario hospital clinical laboratories

The Brock University Research Ethics Board has reviewed the above research proposal.

**DECISION: ACCEPTED AS CLARIFIED. PLEASE SUBMIT REVISED PARTICIPANT MATERIALS INCLUDING WITHDRAWAL INFORMATION, YOUR SPONSOR'S NAME AND CONTACT INFORMATION AND INFORMATION REGARDING THE ACCESS, STORAGE AND DESTRUCTION OF DATA.**

This project has received ethics clearance for the period of **December 18, 2008 to December 31, 2009** subject to full REB ratification at the Research Ethics Board's next scheduled meeting. The clearance period may be extended upon request. *The study may now proceed.*

Please note that the Research Ethics Board (REB) requires that you adhere to the protocol as last reviewed and cleared by the REB. During the course of research no deviations from, or changes to, the protocol, recruitment, or consent form may be initiated without prior written clearance from the REB. The Board must provide clearance for any modifications before they can be implemented. If you wish to modify your research project, please refer to <http://www.brocku.ca/researchservices/forms> to complete the appropriate form Revision or Modification to an Ongoing Application.

Adverse or unexpected events must be reported to the REB as soon as possible with an indication of how these events affect, in the view of the Principal Investigator, the safety of the participants and the continuation of the protocol.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of any research protocols.

The Tri-Council Policy Statement requires that ongoing research be monitored. A Final Report is required for all projects upon completion of the project. Researchers with projects lasting more than one year are required to submit a Continuing Review Report annually. The Office of Research Services will contact you when this form *Continuing Review/Final Report* is required.

Please quote your REB file number on all future correspondence.

MM/an

## Appendix G

## Missing Value Analysis

## Missing Patterns (cases with missing values)

	Case															
	9	12	17	21	80	86	99	108	109	15	87	52	107	24	4	23
# Missing	1	1	1	1	1	1	1	1	2	1	1	1	3	5	13	20
% Missing	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	5.1	2.6	2.6	2.6	7.7	12.8	33.3	51.3
Hosp_type																
Title																
Gender																
IL1																
IL2																
IL3														-		
IL4																
IL6																
Bed_size											S					
IL5									S							
IL7														-		S
IL8																S
IL9																S
CL2																S
CL4																S
CL5										-						S
SV1																S
SV2																S
SV3																S
SV4	+			+	+		-				+		-			S
SV5																S
SV6																S
CL1												S				S
CL3													S			S
CL6					-								S			S
OM5													S		S	S
TL6															S	S
TL7															S	S
OM3															S	
OM2									-						S	
OM1															S	
TL2														S	S	
TL3				+									-	S	S	

TL4															S	S	
TL1															S	S	
TL5															S	S	S
OM6	S															S	S
OM4										S						S	
Years		S	S	S	S	S	S	S	S								

Note: S indicates missing value, - indicates an extreme low value, and + indicates an extreme high value. The range used is (Q1 – 1.5\*IQR, Q3 + 1.5\*IQR).

## Appendix H

## Zscore of Individual Item

## Descriptive Statistics

Questionnaire Item	N	Minimum	Maximum
Zscore(IL1) There are a lot of new things to learn	106	-1.82690	.91993
Zscore(IL2) Continually improve	106	-2.26628	.89458
Zscore(IL3) Tough decision	106	-3.05358	1.33232
Zscore(IL4) Learn from experience	106	-2.67775	1.02453
Zscore(IL5) Learn new work approach	106	-2.76882	1.62262
Zscore(IL6) Always learn something new	106	-3.45605	1.05739
Zscore(IL7) Making mistake is part of process	106	-2.26884	1.36587
Zscore(IL8) Better employee	106	-2.48204	1.08537
Zscore(IL9) Effort to learn	106	-2.97838	1.14853
Zscore(TL1) Team try to improve work process	106	-2.43376	1.26928
Zscore(TL2) Team handle opinion	106	-1.85777	2.12049
Zscore(TL3) Team gets information	106	-2.37901	1.88311
Zscore(TL4) Team seeks new info to change	106	-2.66400	1.65820
Zscore(TL5) Team stops to reflect	106	-2.07537	1.85301
Zscore(TL6) Team speak out to test assumption	106	-2.93398	1.66211
Zscore(TL7) Team invites people from outside	106	-2.53850	1.61185
Zscore(OM1) Critical on shared assumption	106	-2.18385	1.71326
Zscore(OM2) Managers do not want to be questioned	106	-2.37043	1.42703
Zscore(OM3) Open-mindedness	106	-2.50861	1.67899
Zscore(OM4) Think outside the box	106	-2.66703	1.35248
Zscore(OM5) Constant innovation	106	-2.13041	1.50214
Zscore(OM6) Original ideas are highly value	106	-2.43151	1.41535
Zscore(CL1) Manager agrees ability to learn	106	-2.21811	1.70055
Zscore(CL2) Learning is a key improvement	106	-2.42605	1.48217
Zscore(CL3) Learning is an investment	106	-2.24160	1.25266
Zscore(CL4) Learning is a key survival	106	-2.45756	1.33615
Zscore(CL5) Not a learning culture	106	-2.33692	1.20184
Zscore(CL6) Quit learning is danger	106	-2.62153	1.51568
Zscore(SV1) Who are we?	106	-2.56669	1.79805
Zscore(SV2) Total agreement	106	-1.97202	2.39803
Zscore(SV3) Commit to goal	106	-2.02591	2.31240
Zscore(SV4) Employees view as partners	106	-1.75981	2.40093
Zscore(SV5) Share vision among leaders	106	-1.75572	1.60765
Zscore(SV6) Not a well define vision	106	-2.17737	1.43832
Valid N (listwise)	106		

## Appendix I

## Descriptive Statistics of Questionnaire Items

Questionnaire Item	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
<b>INDIVIDUAL LEARNING</b>						
IL1. There are a lot of new things to learn	1	7	4.99	2.184	-.642	-1.203
IL2. Continually improve	5	7	6.43	.633	-.666	-.513
IL3. Tough decision	2	7	5.48	1.140	-.365	-.430
IL4. Learn from experience	4	7	6.17	.810	-.760	.100
IL5. Learn new work approach	1	7	4.78	1.366	-.443	-.146
IL6. Always learn something new	1	7	5.59	1.329	-1.050	1.370
IL7. Making mistake is part of process	1	7	4.75	1.651	-.295	-.733
IL8. Better employee	3	7	5.78	1.121	-.633	-.513
IL9. Effort to learn	3	7	5.89	.969	-.729	.220
Average						
<b>TEAM LEARNING</b>						
TL1. Team try to improve work process	1	7	4.94	1.620	-.824	.086
TL2. Team handle opinion	1	7	3.80	1.508	.056	-.659
TL3. Team gets information	1	7	4.35	1.408	-.332	-.015
TL4. Team seeks new info to change	1	7	4.70	1.388	-.420	.031
TL5. Team stops to reflect	1	7	4.17	1.527	-.292	-.526
TL6. Team speak out to test assumption	1	7	4.83	1.305	-.647	.461
TL7. Team invites people from outside	1	7	4.67	1.446	-.578	.303
<b>OPEN-MINDEDNESS</b>						
OM1. Critical on shared assumption	2	7	4.80	1.283	-.310	-.234
OM2. Managers do not want to be questioned	1	7	4.75	1.580	-.677	-.223
OM3. Open-mindedness	1	7	4.59	1.433	-.322	-.209
OM4. Think outside the box	1	7	4.98	1.493	-.685	.007
OM5. Constant innovation	1	7	4.52	1.652	-.292	-.624
OM6. Original ideas are highly value	1	7	4.79	1.560	-.414	-.451
<b>COMMITMENT TO LEARNING</b>						
CL1. Manager agrees ability to learn	2	7	4.83	1.276	.045	-.414
CL2. Learning is a key improvement	2	7	5.10	1.279	-.448	-.024
CL3. Learning is an investment	1	7	4.85	1.717	-.635	-.362
CL4. Learning is a key survival	1	7	4.89	1.582	-.664	-.069
CL5. Not a learning culture	1	7	4.96	1.696	-.705	-.591



CL6. Quit learning is danger	1	7	4.80	1.450	-.544	.143
<b>SHARED VISION</b>						
SV1. Who are we?	1	7	4.53	1.375	-.172	-.419
SV2. Total agreement	1	7	3.71	1.373	.185	-.175
SV3. Commit to goal	1	7	3.80	1.383	.056	-.239
SV4. Employees view as partners	1	7	3.54	1.442	.253	-.194
SV5. Share vision among leaders	1	7	4.13	1.784	-.069	-.915
SV6. Not a well define vision	1	7	4.61	1.659	-.305	-.708

Note. SE skewness 0.235, SE kurtosis 0.465